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December 1994

US Army Corps
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Waterways Experiment
Station

Ship Simulation Study of Mobile Turning Basin Development Plan, Mobile, Alabama

by J. Christopher Hewlett

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Prepared for U.S. Army Engineer District, Mobile

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Waterways Experiment Station
3909 Halls Ferry Road
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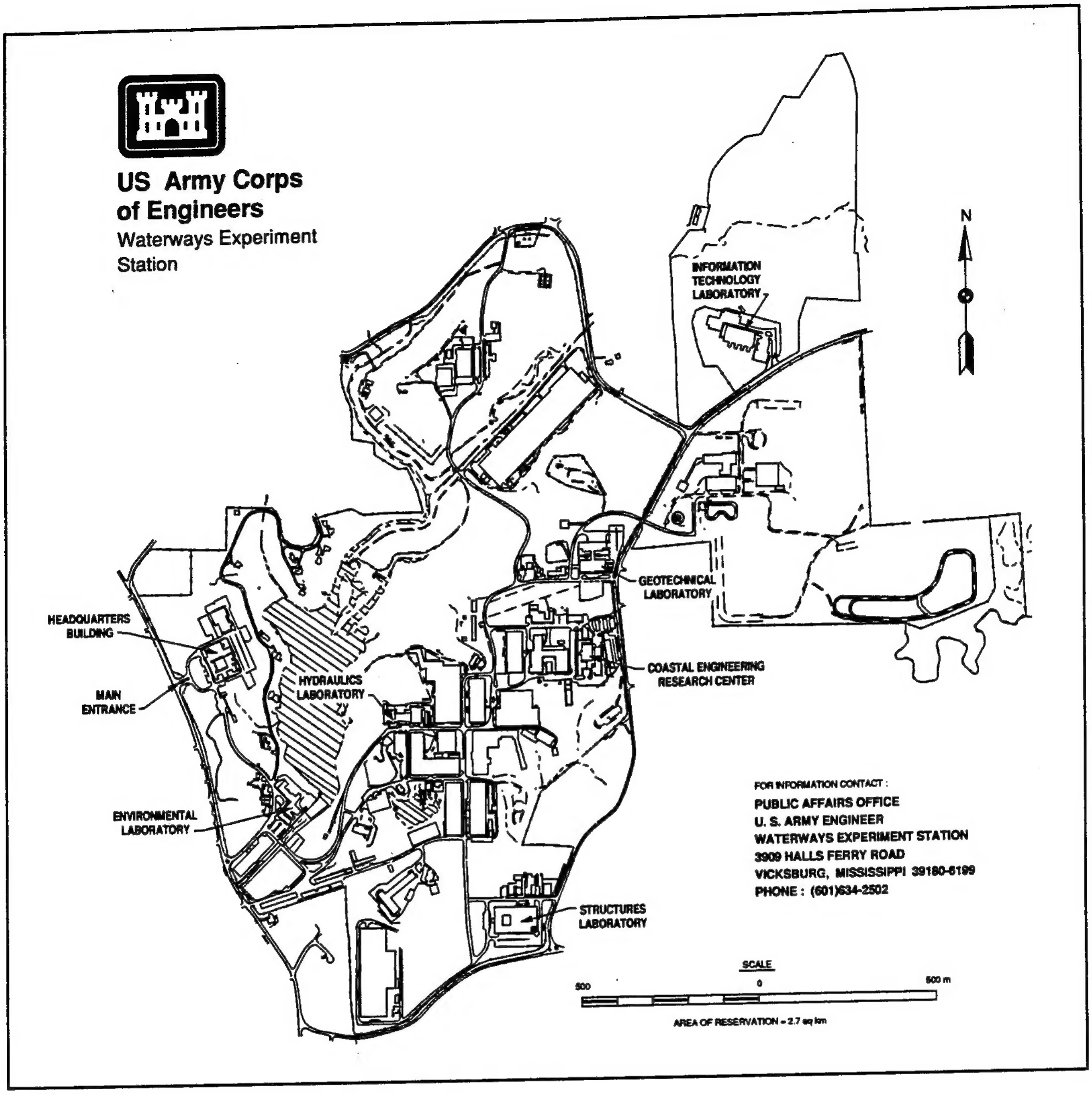

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Contents

Preface

This investigation was performed by the Hydraulics Laboratory (HL), U.S. Army Engineer Waterways Experiment Station (WES), for the U.S. Army Engineer District, Mobile. The simulations were carried out at the WES Ship/Tow Simulator in Vicksburg, MS.

The study was conducted at WES during the period November 1992 through January 1994 by Mr. J. Christopher Hewlett, Navigation Branch, Waterways Division, HL, under the general supervision of Messrs. Frank A. Herrmann, Jr., Director HL; Richard A. Sager, Assistant Director, HL; Dr. Larry L. Daggett, Acting Chief, Waterways Division, and Chief, Navigation Branch.

The responsible engineer at the Mobile District during the study was Mr. Greg Miller. Acknowledgement is made to the Mobile Bay Bar Pilots Association and individual pilots who participated in the study. Also, acknowledgment is made to Ms. Donna Derrick, HL technician, WES, who prepared the plates of the study results.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Bruce K. Howard, EN.

Conversion Factors, Non-SI to SI Units of Measurement

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
feet	0.3048	meters
horsepower (550 foot-pounds (force) per second)	745.6999	watts
knots (international)	0.5144444	meters per second
miles (U.S. nautical)	1.852	kilometers
tons (long, 2,240 lb)	1,016.047	kilograms

1 Introduction

Background

The US Army Engineer District, Mobile, has proposed a plan for the addition of a turning basin adjacent to the McDuffie Island Coal Terminal at the entrance to Mobile Harbor, Alabama. This coal facility is the second largest in the U.S. with a capacity of 23 million tons[1] per annum[2]. The main purpose of the proposed addition is to provide a safe and efficient turning area for the large bulk carriers calling at the coal terminal. Presently, ships slightly less than 1000 ft in length come to the terminal and turn around in a "wide spot" in the channel just south of Little Sand Island. Ships are turned when inbound in an empty condition and trimmed by the stern (bow up). Clockwise turning is the norm, with the bow swinging to the east and the stern remaining close to the terminal dock. The largest ships are turned when at least one of the berthing areas at the terminal is unoccupied to allow use of the space near the dock for maneuvering. Trimming by the stern is required so that the bow will clear the bottom on the eastern side of the channel. The design proposals are aimed at alleviating or eliminating the need for this trimming and providing a basin with enough room for ships to turn without relying on unoccupied berthing space. Figure 1 shows the immediate simulator test area and the existing depth contours[3].

The Mobile District requested the US Army Engineer Waterways Experiment Station (WES) Hydraulics Laboratory to conduct a ship simulation study for the design of the proposed turning basin. The objective of this study was to evaluate the proposed turning basins and recommend a final design. The scope of the study encompassed testing the existing channel and four proposed turning basin designs. The District submitted three of the proposed designs and WES engineers produced one additional design during the simulator testing program. The project design ship was a 150,000 dead-weight-tons (DWT) bulk carrier with a length overall (LOA) of 950 ft and a beam of 145 ft.

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1 A table of factors for converting non-SI units of measurement to SI (metric) units is found on page v.

2 Alabama State Docks, P.O. Box 1588, Mobile, Alabama.

3 Mobile District dredging survey data, June 1992.

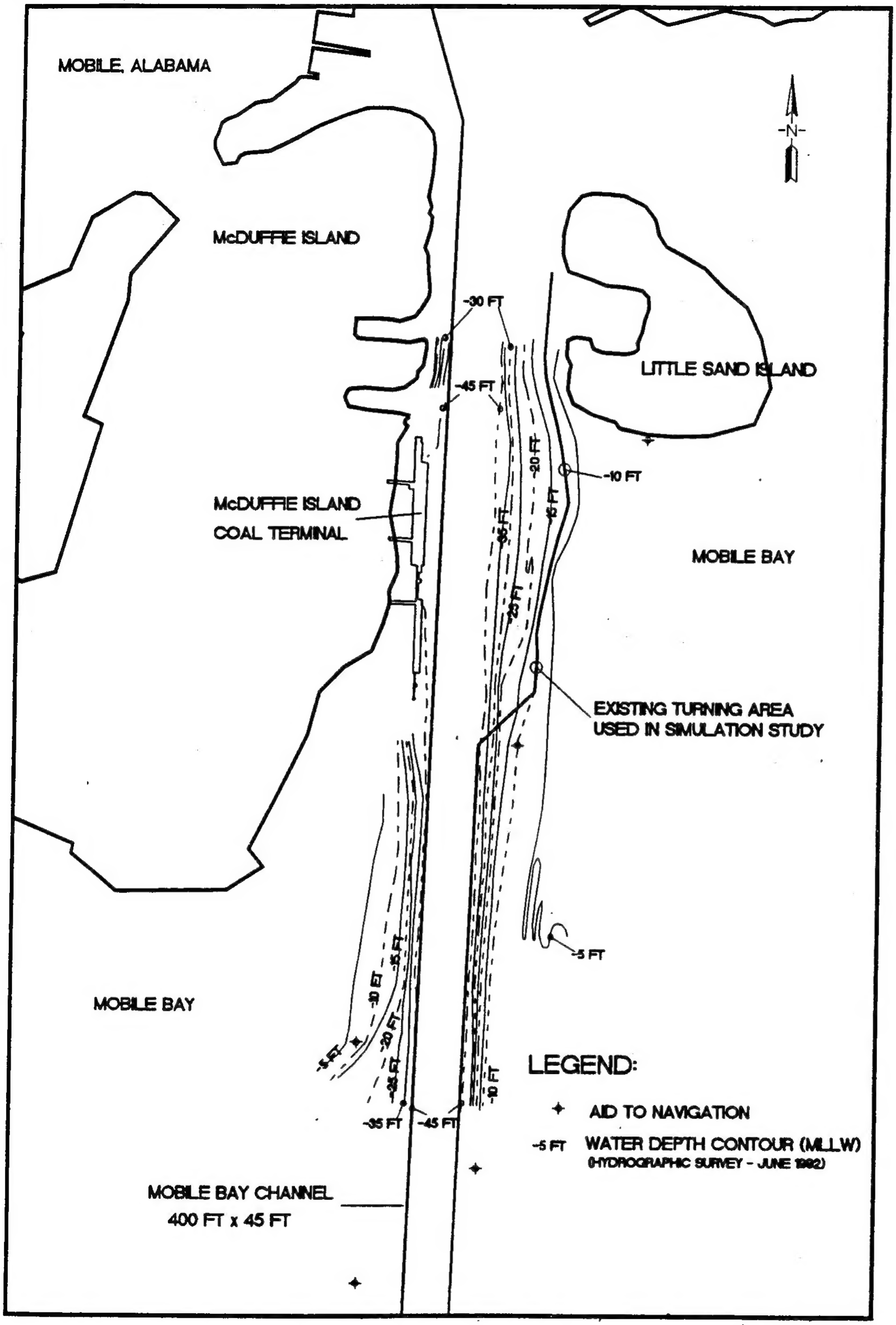

Figure 1. Study vicinity and existing bathmytry

According to traffic records from 1989[1], vessels greater than 950 ft in length called at McDuffie terminal on seven occasions (five different ships). In all these cases the midship draft was less than 33 ft. According to the pilots conducting the simulation tests, ships would primarily be brought in empty, at drafts less than 33 ft, to allow taking on a full load of coal at the terminal. However, ship drafts of 33 ft will probably increase in frequency in the future and were used in the simulation study to provide a conservative design for the proposed turning basin. For the existing and one of the proposed turning basins the ship had a draft trimmed to 35 ft at the stern and 15 ft at the bow. In the other three proposed turning basins the ship had an even-keel draft of 33 ft.

Channel Geometry and Proposed Changes

Existing channel conditions are shown on figure 1. For convenience the existing turning area was defined as being limited on the east by the -10 ft mean-lower-low-water (mllw) contour. Figure 2 shows the layouts of the four proposed configurations. Plan 1 was the largest basin in area with a stepped depth of -35 ft and -29 ft mllw. This plan was designed to allow turning alongside the McDuffie terminal with trimmed ships. Plan 2 was designed for turning opposite the terminal and was a smaller size than Plan 1. Plan 3 was similar to Plan 2 with the exception of being moved farther north, in closer alignment with the existing turning area. Plan 4 was developed during pilot testing as a design alternative and was similar in surface area to Plan 1 but had a different shape and was moved farther north. Plans 2,3 and 4 had a depth of -35 ft mllw, and a ship with an even-keel draft of 33 ft was tested.

1 1989 Vessel Clearance Statistics, McDuffie Terminal, Port of Mobile.

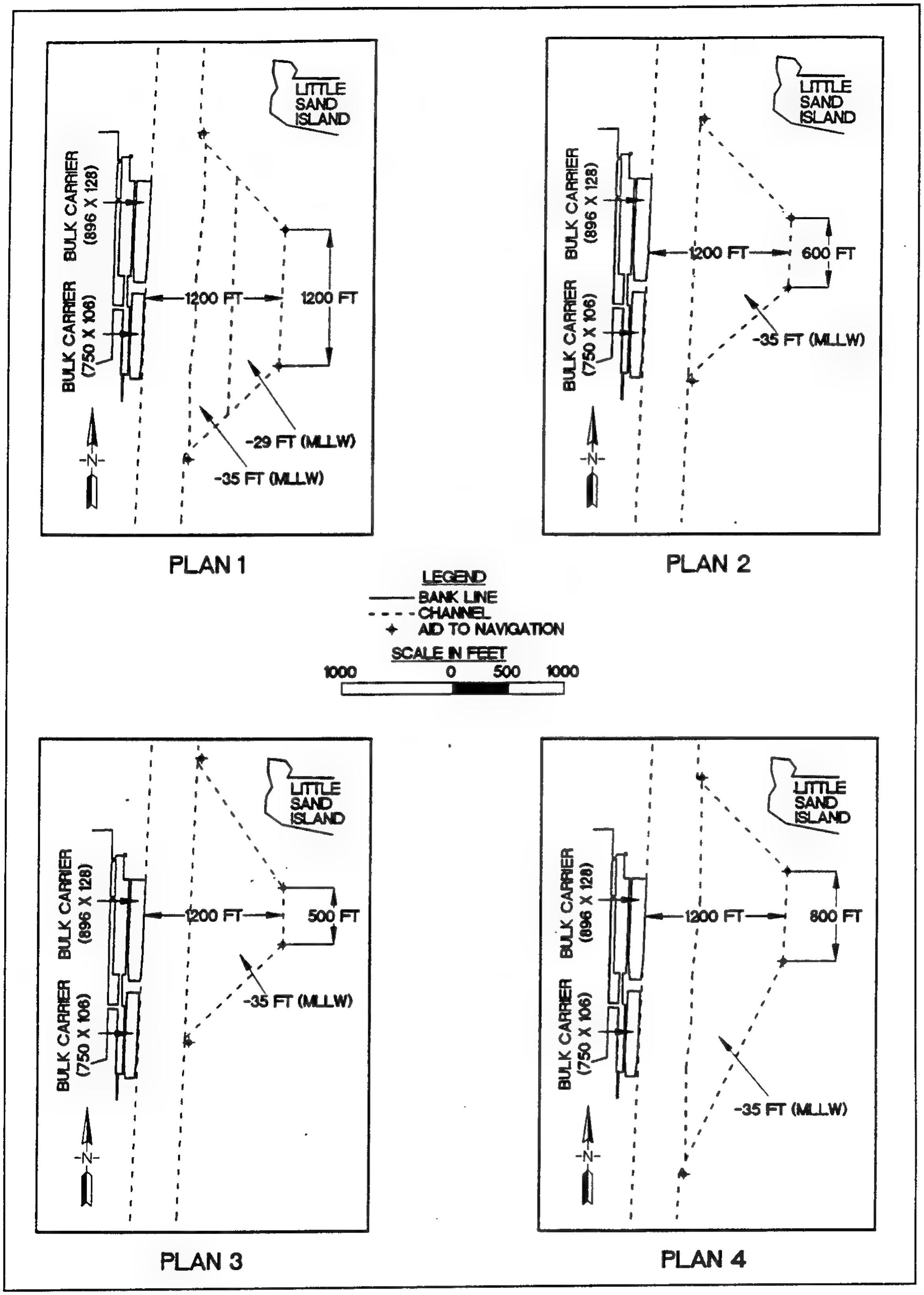

Figure 2. Test Basins

2 Data Base and Test Conditions

Visual Data Bases

The visual scene and simulated radar data bases encompassed a fairly small area in the vicinity of the turning basin. The development of the visuals was accomplished using land and aerial photographs, dredging survey charts supplied by the district, navigation charts and quadrangle sheets. The primary interest was the McDuffie terminal and official and unofficial aids to navigation. The only change between existing and proposed conditions visible to the pilots on the simulator was the rearrangement of the aids to navigation. For the proposed conditions, navigation markers were placed at the four corners of the basins so as to indicate the maneuvering area available to the pilots. Figure 3 is a photograph of the computer generated visual scene of the study area showing the bow of the design ship approaching the coal terminal area. Figure 4 shows an example of the simulated radar view in the turning basin area; the arrows indicate the method of demonstrating direction and magnitude of forces resulting from usage of tugs.

Currents

Figures 5 - 12 show a sample of the different current/basin-configuration combinations tested during the simulations. Figure 5 shows the flow conditions in the existing basin as measured on 13 January 1993 by a team from WES. Equipment was used which measured current velocity and direction at approximately 1-ft depth intervals. In addition, discharge measurements were recorded simultaneously. About 1/2 mile upriver from Little Sand Island, the Mobile River discharge rate for 13 January 1993 was approximately 60,000 cubic feet per second (cfs). A previous model study for Mobile Bay (Lawing, Boland and Bobb 1975) indicates that this discharge rate would result from a combined Mobile-Tensaw Rivers rate of about 120,000 cfs. The earlier study also indicates that at combined discharge rates of this magnitude the flow splits equally at the bifurcation of the Mobile and Tensaw Rivers. However, more recent data from the District indicate that the Mobile/Tensaw

Figure 3. Photograph of Mobile Harbor Visual Scene

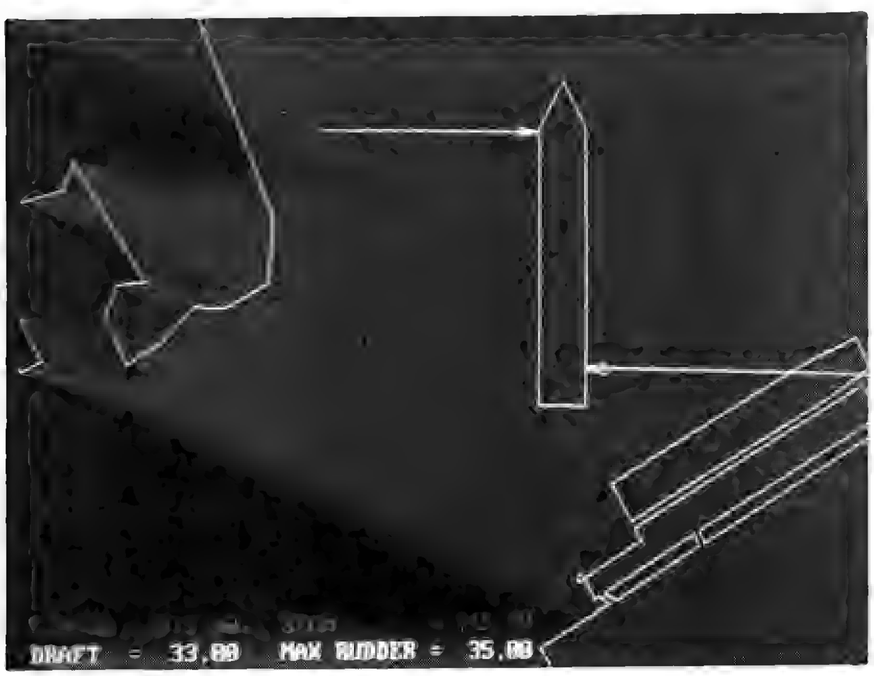

Figure 4. Photograph of simulated radar in vicinity of McDuffie Terminal

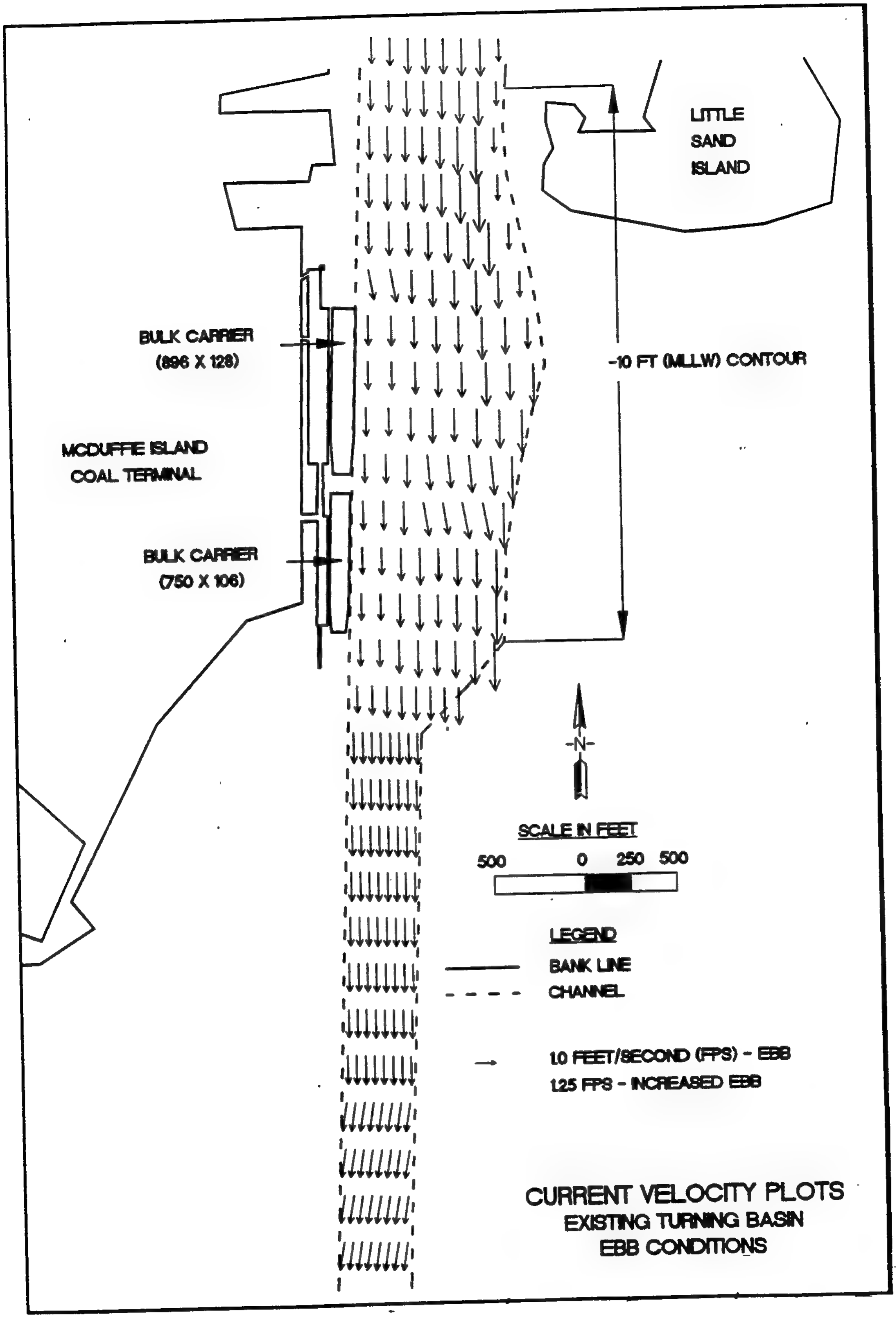

Figure 5. Existing channel currents - Ebb tide

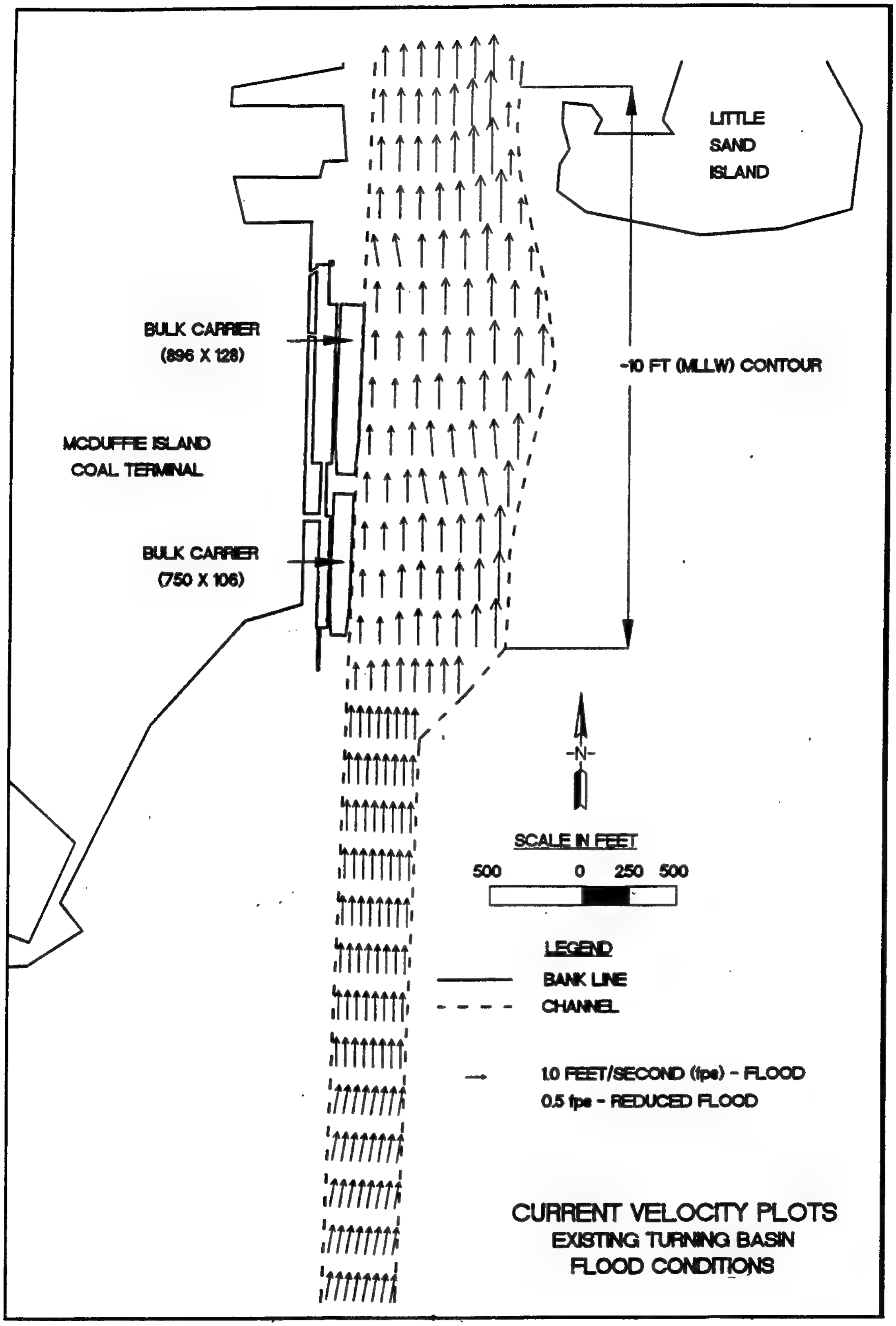

Figure 6. Existing channel currents - Flood tide

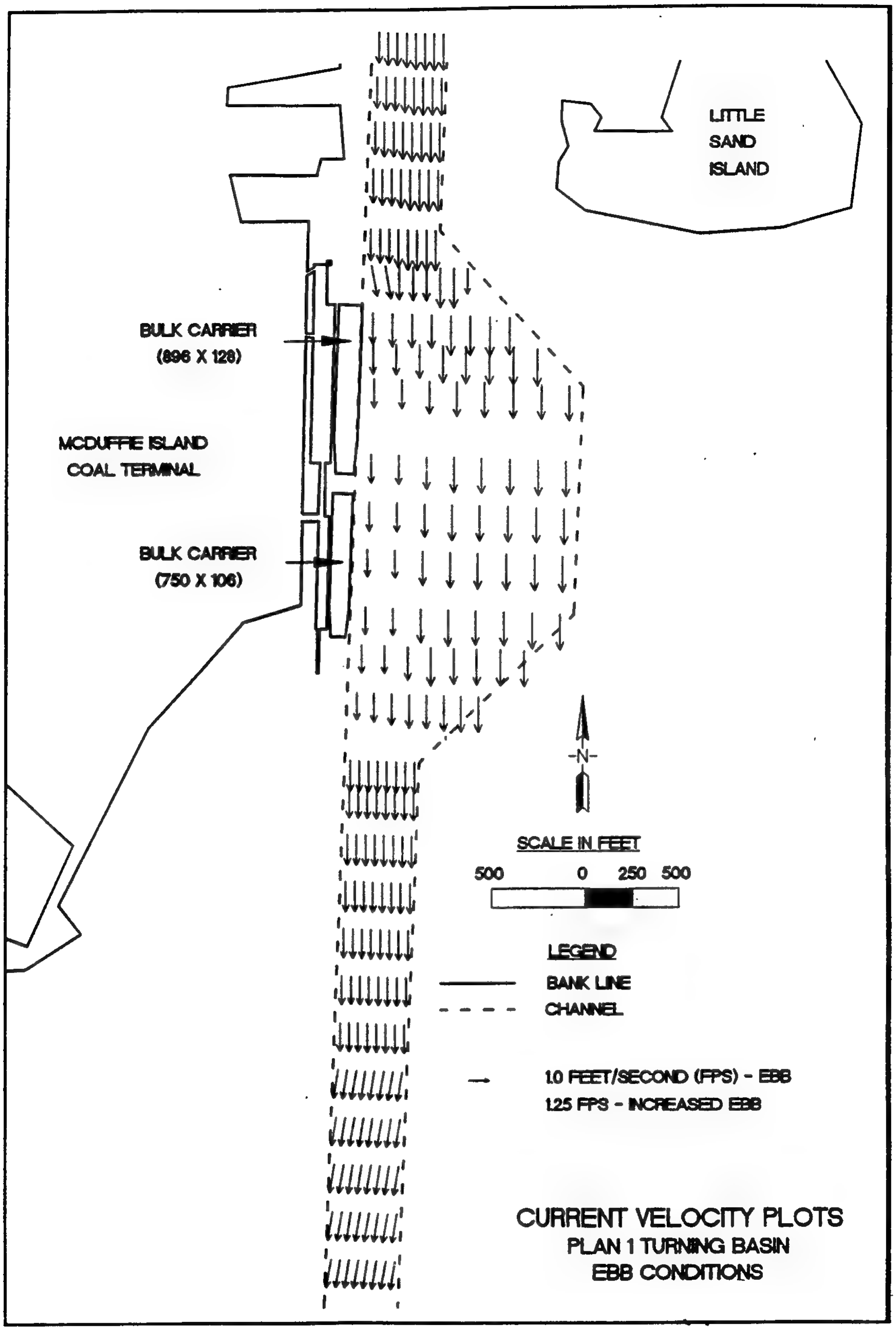

Figure 7. Plan 1 currents - Ebb tide

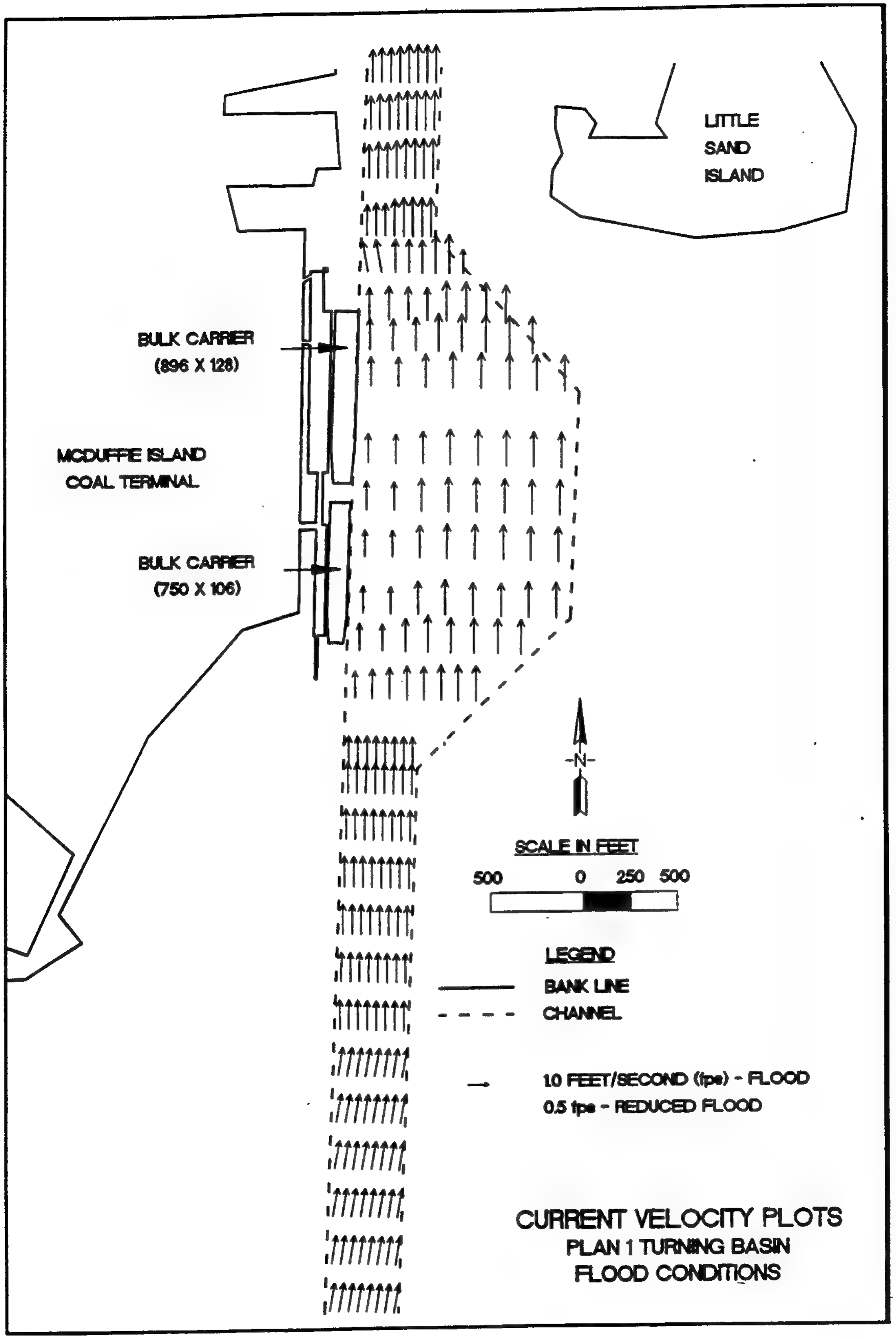

Figure 8. Plan 1 currents - Flood tide

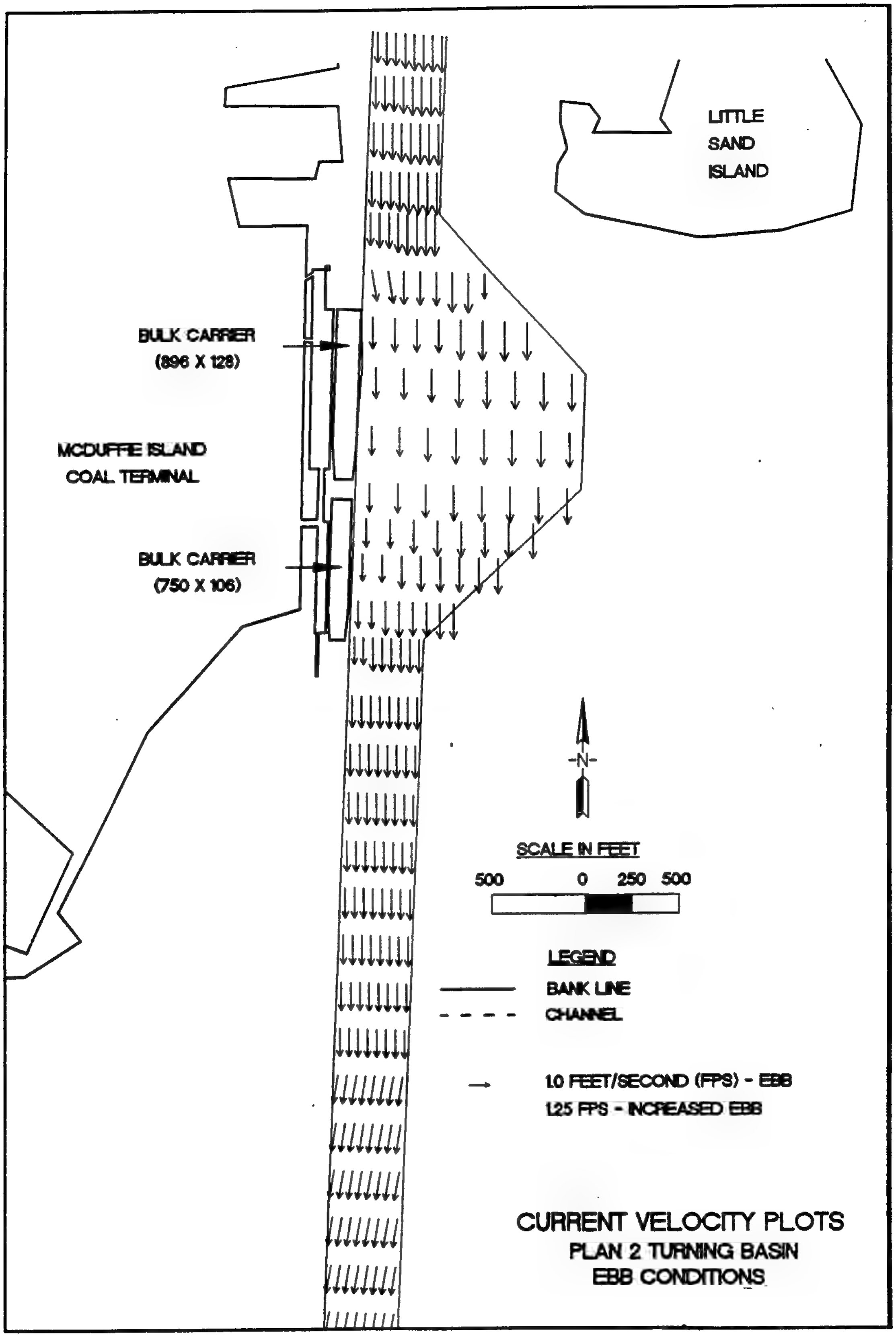

Figure 9. Plan 2 currents - Ebb tide

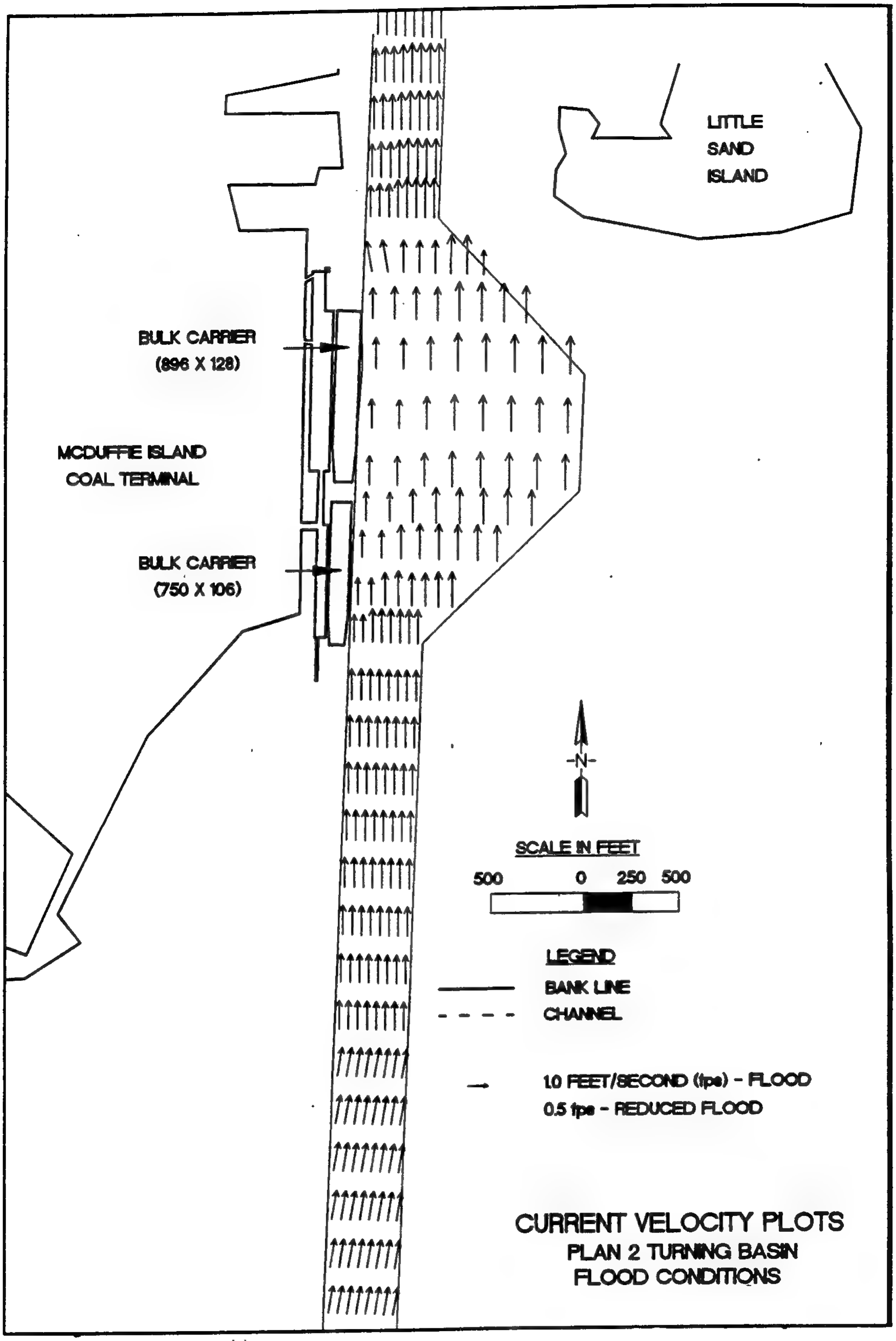

Figure 10. Plan 2 currents - Flood tide

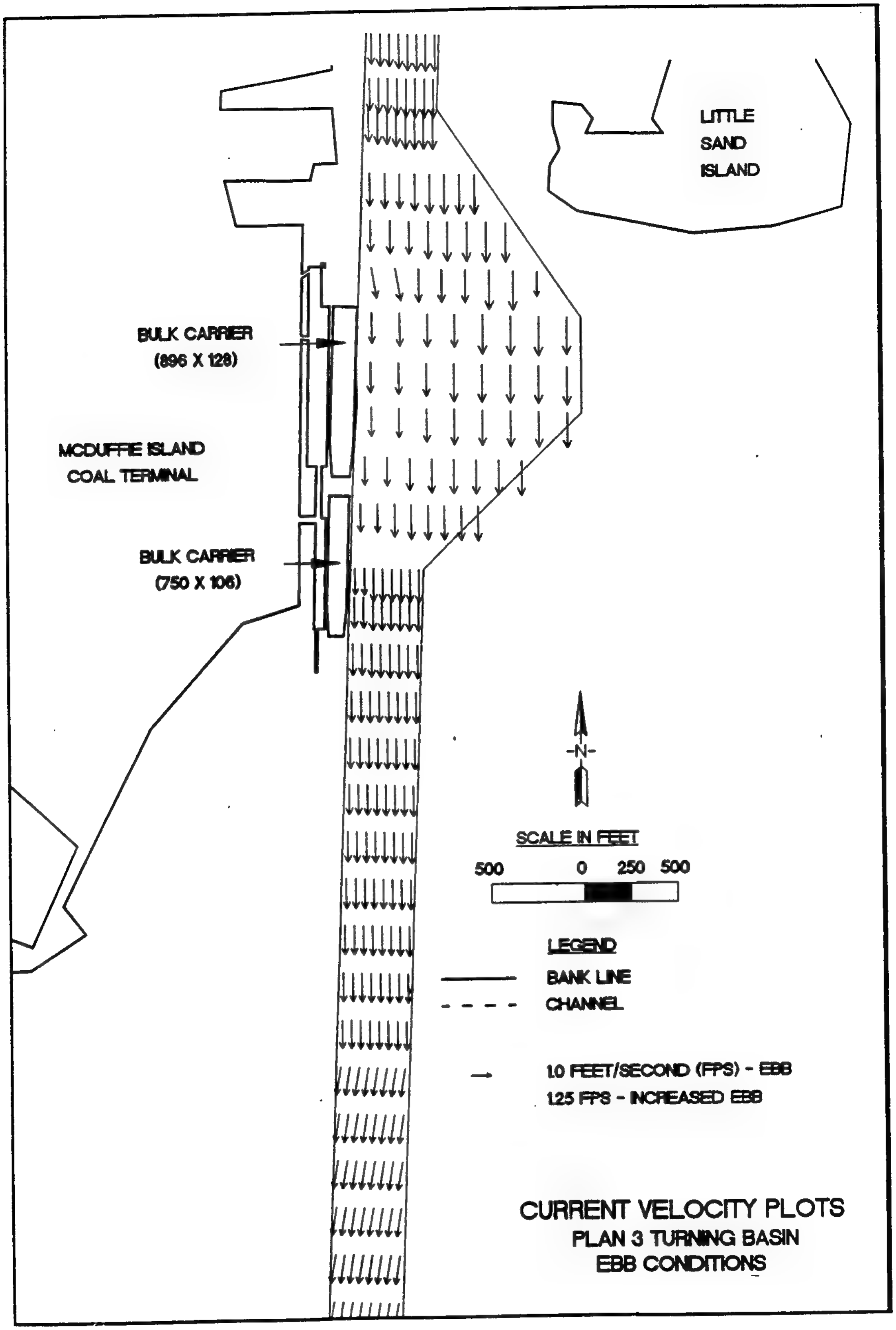

Figure 11. Plan 3 currents - Ebb tide

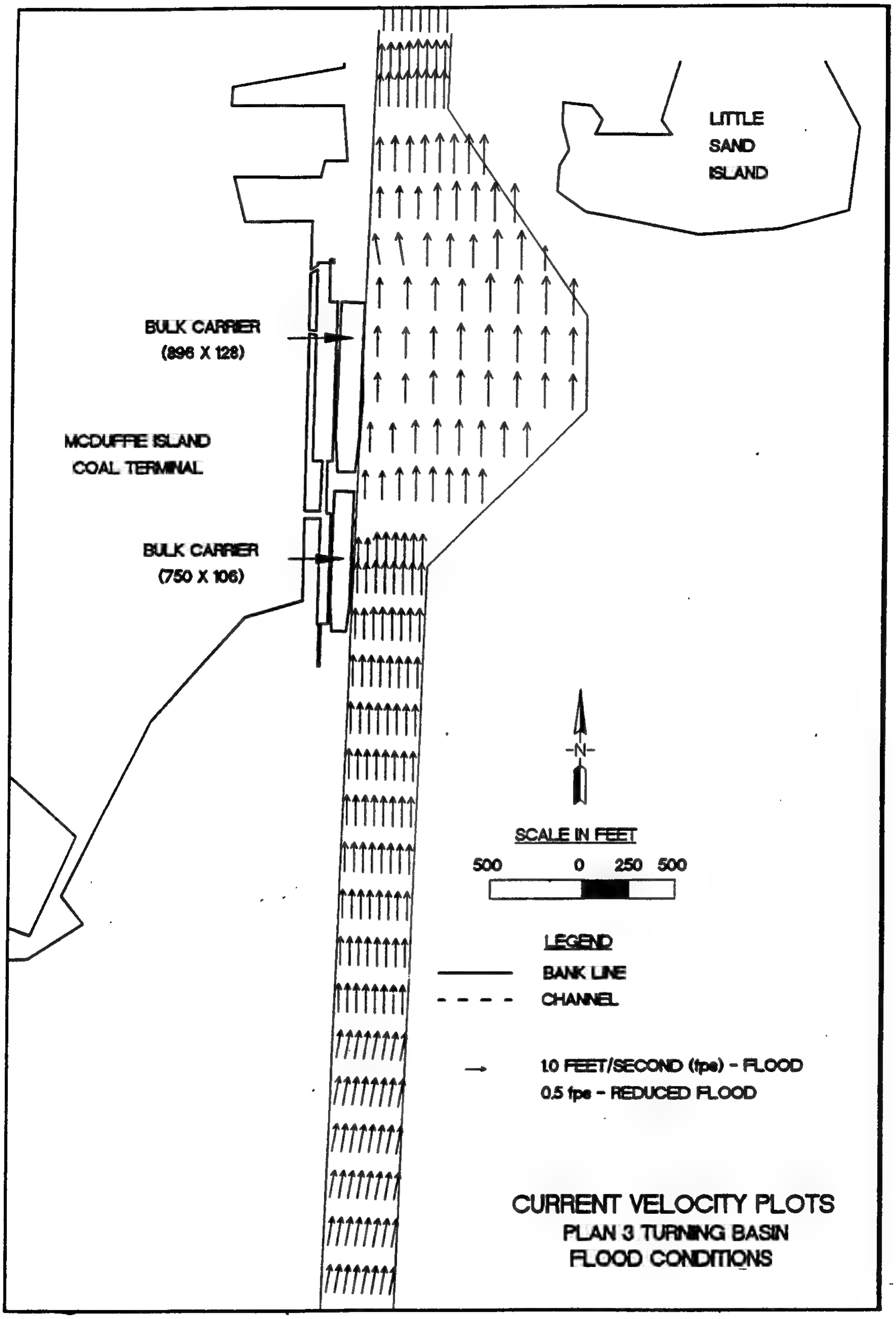

Figure 12. Plan 3 currents - Flood tide

Rivers flow split is closer to 35%/65%, respectively, at the discharge level measured. This results in an approximate 160,000 cfs for the combined rivers flow which, according to the discharge frequency data provided by the District, is exceeded only 10% of the time. Although there is no available frequency-of-occurrence data on actual current magnitude or direction in the study area, the 13 January 1993 discharge rate indicates that the measured flow was stronger than average.

For simulator current input, measured current vector orthogonal components were averaged over the depth interval from the surface to -35 ft (or less in shallower areas) and then resolved vectorially for determination of current direction. This process used only data from a water column as deep as the design ship. Although higher velocities were measured in the shallower water on the east side of the test basin, in the main part of the channel, nearer to the coal dock, a representative depth-averaged current magnitude of 1.5 fps was measured. During validation the pilots stated that the measured ebb tide currents were not as strong as they were used to; therefore, an increased ebb condition was created by raising the magnitude 25% in the entire simulator test basin. For this modified condition the current directions remained the same. During the field data exercise no flooding tide was measured. However, at times the current direction <u>does</u> reverse in the study area and flows north. This flood condition occurs less frequently than ebb tide (southward flow) and mainly during times of low fresh water flow from the Alabama, Black Warrior, and Tombigbee Rivers.

In acknowledgment of a different turning strategy requirement, a simulated flood tide was implemented in the test program by reversing the directions of the measured ebb tide (for existing channel see figure 6). This is not very accurate, but the measured current data indicates that at least during peak ebb flow the spatial variation of the current directions is small. Since construction of any of the proposed plans is not expected to change the current pattern appreciably, numerical modeling of the area was not considered necessary for good simulation results. After some testing, the pilots indicated that the simulator flood currents were stronger than they normally experience during flooding conditions; therefore, a reduced flood condition was created by decreasing the magnitude by 50%, resulting in a representative current of about 0.75 fps. To summarize, there were four different current conditions used for simulation tests: ebb flow (measured), increased ebb flow, flood flow and reduced flood flow. These four data bases provided a good range of conditions for simulator testing.

Development of current data for the <u>proposed</u> conditions was accomplished by assuming a slight reduction in magnitude resulting from dredging of the basin to project depth. The measured current data show that the magnitude increased as the water depth decreased toward the eastern side of the channel. For the proposed basins the current magnitudes for the areas deepened to -35 ft (mllw) were assigned a value close to that occurring in the existing basin at the same depth. The same procedure was used for areas deepened to -29 ft (mllw) in the proposed basins. In some of the proposed plans the northern

edge of the basin was located in the lee of Little Sand Island during times of ebbing flow. In these areas the current magnitude was reduced to approximate the main flow separation zone south of the island. Figures 7 - 12 show the current pattern used for the proposed plans.

Wind

During all of the simulator runs a southeasterly wind of 10 knots was used. Southeasterly winds are a common occurrence in the Mobile area, especially during the summer months. Also, since there is open water toward the south in the area, winds from this general direction would be the least impeded in regard to ship maneuvering. Winds from the southeasterly direction introduced a cross-channel component which affected the pilots ability to maintain the channel course.

Design Ship

The design ship used in the turning basin study was a 150,000 DWT bulk carrier with a LOA of 950 ft and beam of 145 ft. This was the same ship model used in the Upper Mobile Bay Channel ship simulation study (Huval, 1985); however, the drafts were different. Designers and Planners. Inc. was contracted to modify the original ship numerical model for the needs of the present study (Ankudinov,1993). Special attention was paid to the hydrodynamic characteristics of the trimmed ship because it was an unusual condition.

Tugs

Based on actual practice defined by the pilots, a maximum of three 4000-horsepower tugs were made available during the simulation runs. The pilot could place the tugs at any of four locations about the ship: port bow and quarter and starboard bow and quarter. Specific usage of tugs is discussed in the section on test results.

3 Study Results

Validation Tests

Prior to pilot testing, two Mobile pilots visited WES for validation of the simulation data bases. Testing during this period was restricted to the existing condition in order to obtain information from the pilots based on their experience. During the validation the pilots reported that they were accustomed to stronger ebb currents than those measured for the study; although, the pattern and direction of the currents were considered accurate. Based on these comments, additional current conditions were developed as set forth in the earlier section on currents. Concerning other data bases, the pilots were satisfied with the visual scene except for the absence of an existing piling placed at the eastern edge of deep water opposite the terminal dock. The pilots said they use the piling as a reference point during turning maneuvers and it was added to the existing channel visual scene in its approximate position south of Little Sand Island. In addition to these data base changes, some modifications to the ship hydrodynamic coefficients were made to allow for conditions in the terminal area. In the initial tests the pilots determined that the wind forces were too strong; therefore, the air drag coefficients were reduced to simulate more realistic effects.

Simulator Scenarios

A total of six professional pilots from Mobile Bay Bar Pilots Association conducted tests for the simulation study. Two pilots visited WES on each of three weeks for testing. The following tables list the simulator runs which were included in the study analysis. The tables also show a scenario/plate cross-reference list to aid in review. Each individual trackplot is placed opposite the coincident plot of tug induced <u>lateral</u> force and moment recorded during the run (Plates 1 - 128). Plates 129 - 146 show composite trackplots of the runs.

Existing Channel Scenarios - Plate Number Reference					
			Trackplots		
Pilot	Ship	Current	Individual	Composite	Tugs
C	Trimmed	Ebb	1	129	2
D	Trimmed	Ebb	3	129	4
E	Trimmed	Inc. Ebb	5	130	6
F	Trimmed	Inc. Ebb	7	130	8
C	Trimmed	Red. Flood	9	131	10
D	Trimmed	Red. Flood	11	131	12

Plan 1 Scenarios - Plate Number Reference					
			Trackplots		
Pilot	Ship	Current	Individual	Composite	Tugs
C	Trimmed	Ebb	13	132	14
D	Trimmed	Ebb	15	132	16
A	Trimmed	Inc. Ebb	17	133	18
B	Trimmed	Inc. Ebb	19	133	20
C	Trimmed	Inc. Ebb	21	133	22
D	Trimmed	Inc. Ebb	23	133	24
E	Trimmed	Inc. Ebb	25	133	26
F	Trimmed	Inc. Ebb	27	133	28
C	Trimmed	Flood	29	134	30
C(#2)	Trimmed	Flood	31	134	32
D	Trimmed	Flood	33	134	34
E	Trimmed	Flood	35	134	36
F	Trimmed	Flood	37	134	38
C	Trimmed	Red. Flood	39	135	40
D	Trimmed	Red. Flood	41	135	42
E	Trimmed	Red. Flood	43	135	44
F	Trimmed	Red. Flood	45	135	46

Plan 2 Scenarios - Plate Number Reference					
			Trackplots		
Pilot	Ship	Current	Individual	Composite	Tugs
C	33 ft	Ebb	47	136	48
D	33 ft	Ebb	49	136	50
A	33 ft	Inc. Ebb	51	137	52
B	33 ft	Inc. Ebb	53	137	54
C	33 ft	Inc. Ebb	55	137	56
D	33 ft	Inc. Ebb	57	137	58
E	33 ft	Inc. Ebb	59	137	60
F	33 ft	Inc. Ebb	61	137	63
A	33 ft	Flood	63	138	64
B	33 ft	Flood	65	138	66
C	33 ft	Flood	67	138	68
D	33 ft	Flood	69	138	70
E	33 ft	Flood	71	138	72
F	33 ft	Flood	73	138	74
C	33 ft	Red. Flood	75	139	76
D	33 ft	Red. Flood	77	139	78
E	33 ft	Red. Flood	79	139	80
F	33 ft	Red. Flood	81	139	82

Trackplots and Tug Usage

An important point to consider when reviewing the simulator results is that for the proposed turning basins the pilots were restricted to an authorized basin boundary by the placement of a docked ship at the northern end of the McDuffie Terminal. Conversely, present pilot practice in the existing basin restricts turning of large vessels to times when no ship is docked in this position, allowing use of the berthing area for maneuvers. This demonstrates that the aim of the simulator study was to require the pilots to utilize only the authorized channel.

Plan 3 Scenarios - Plate Number Reference					
			Trackplots		
Pilot	Ship	Current	Individual	Composite	Tugs
C	33 ft	Ebb	83	140	84
D	33 ft	Ebb	85	140	86
A	33 ft	Inc. Ebb	87	141	88
B	33 ft	Inc. Ebb	89	141	90
E	33 ft	Inc. Ebb	91	141	92
F	33 ft	Inc. Ebb	93	141	94
A	33 ft	Flood	95	142	96
B	33 ft	Flood	97	142	98
C	33 ft	Flood	99	142	100
D	33 ft	Flood	101	142	102
E	33 ft	Flood	103	142	104
F	33 ft	Flood	105	142	106
C	33 ft	Red. Flood	107	143	118
E	33 ft	Red. Flood	109	143	110
F	33 ft	Red. Flood	111	143	112

Plan 4 Scenarios - Plate Number Reference					
			Trackplots		
Pilot	Ship	Current	Individual	Composite	Tugs
E	33 ft	Inc. Ebb	113	144	114
E(#2)	33 ft	Inc. Ebb	115	144	116
F	33 ft	Inc. Ebb	117	144	118
E	33 ft	Flood	119	145	120
F	33 ft	Flood	121	145	122
E	33 ft	Red. Flood	123	146	124
E(#2)	33 ft	Red. Flood	125	146	126
F	33 ft	Red. Flood	127	146	128

Existing Channel

Plates 1 - 11 (odd numbers) and Plates 129 - 131 show the individual trackplots and composite trackplots, respectively, from the existing basin runs. These results are representative of pilot strategies currently used for turning large vessels next to the McDuffie Terminal. Plates 1,3,5,7,129 and 130 depict the usual ebb tide pilot strategy in which the vessel is taken far to the north in the turning area and is turned to the east with the bow swinging through very shallow water in the vicinity of Little Sand Island. The most significant characteristic of these runs is the extent to which the unoccupied berthing area at the northern end of the terminal is used by the pilots. As evidence of the validity of the simulation, the pilots stated that these runs were representative of actual practice in which the stern of the vessels come within a distance of less than 50 ft to the McDuffie dock. There is little difference between the turns in the two different ebb tide conditions or in tug usage (Plates 2,4,6 and 8). Usually the pilots used two tugs at the bow on the simulator: one on the port side pushing full and the other on the starboard side backing full. The other tug was usually used on the starboard quarter to hold the stern into the ebbing current. In "real-world" conditions, two tugs would be used on the port bow pushing full; however, this was not possible on the simulator and the detailed arrangement allowed this operation to be effectively represented. Plates 9 - 12 and 131 show trackplots and tug usage for the flood tide strategy for turning in the existing channel. The turn is made farther south than in ebb tide to allow for northward drift. This practice allows the pilots to make the turn at the widest part of the existing turning area. During flood tide the pilots reversed the ebb tide practice by placing one tug on each quarter and one at the bow. This kept the stern from advancing too far upriver.

Plan 1

Plates 13 - 46 and 132 - 135 show the results from the simulations for the Plan 1 basin. These tests were conducted with the same trimmed ship as in the existing configuration. The most significant result from these track plots is the difficulty which the pilots experienced in staying clear of the docked ships during flood tide. During the study, individual simulations were terminated prior to the turning maneuver if contact with the docked ships was noted. The difficulty was less pronounced in ebb tide (Plates 13 - 28 and 132 - 133) than for flood tide (Plates 29 - 46 and 134 - 135); although one run in ebb conditions (Plate 15) resulted in the ship colliding with one of the docked ships. In the flood tide cases the southeast wind compounded the problems resulting from the northward drift caused by the current. Four of the five runs conducted in the flood tide resulted in failure (Plates 29 - 38). The run shown on Plate 35 ended with the vessel running out of the northern edge of the basin because the pilot was unsuccessful in getting far enough away from the docked ship to start the turn. The tug-usage plots indicate that significant tug lateral force was used by the pilots to control their ships. Plates 39 - 46, depicting runs in a less severe flood condition, do not show any failures;

however, the maneuver still required the tugs to bodily push the vessel into the basin in order to yield enough stern room for the turn. These particular results and subsequent results from Plans 2 and 3 indicate that flooding tide will be the predominant concern for future operations. One of the prime factors resulting in maneuvering difficulty in the proposed plans is the constriction point between the docked ships and the southern corner of the turning basins. The proposed configurations do not allow pilots the ability to steer their ships away from the berthing area early enough for a safe turn.

Plan 2

Plates 47 - 82 and 136 - 139 show the results from the simulation runs for Plan 2. Plates 47 - 50 show successful runs in the measured ebb tide condition; however, the runs in the increased ebb condition, Plates 51 - 62 indicate that Plan 2 is not large enough for safe turning operations. Flood tide runs on Plates 63 - 74 show the same difficulty in staying clear of the docked ships as was evident in the Plan 1 tests. There is comparative improvement in the reduced flood runs shown on Plates 75 - 82; however, a strong tendency to favor the southern corner of the turning basin again indicates the need to enter the basin as far to the east (away from the dock) as possible. Many of the tug-usage plots for Plan 2 simulator runs show large lateral tug forces indicating the difficulty the pilots were having controlling the deeper draft test ship against the simulated wind and currents.

Plan 3

Plates 83 - 112 and 140 - 143 show the results from the proposed Plan 3 simulation tests. Plates 83 - 86 show the two runs conducted in the measured ebb tide condition. One of these runs was unsuccessful and was terminated early, the other run was a well controlled turning maneuver. The unsuccessful run may have been the result of unfamiliarity resulting from the pilot being asked to adjust to conditions with which he is not accustomed. Plates 87 - 94 showing runs in the increased ebb conditions indicate minimally adequate room for the turning maneuver and shows that the alignment of the northern edge precludes use of a large part of the dredged basin. Plates 95 - 106 show major difficulties, again, in maneuvering the vessel during flood tide. Plates 107 - 112 show improvement due to the reduced strength of the flooding tide but again shows favoring of the eastern channel edge when entering the basin.

Plan 4

After the first four pilots conducted tests, a fourth basin configuration (Plan 4) was developed as a recommended alignment for the purpose of addressing the difficulties experienced in the original three proposed designs, see figure 2. This design had two primary objectives: (a) to accommodate the desire of the pilots to turn the vessels as far to the north as possible to

alleviate the need of backing to the McDuffie berths once the turn is completed and (b) to widen the constriction at the southern end of the basin to allow earlier entry into the turning area. The second objective was aimed at efficient operations during times of flooding tide. The currents used for the simulator study in Plan 4 are shown on Figures 13 and 14. Plates 113 - 128 show the Plan 4 tests conducted by the last two pilots. The runs with increased ebb conditions, Plates 113 - 118 included one which was unsuccessful and another which was marginally successful. As was discussed earlier, this probably resulted from the very common problem of pilot unfamiliarity and the need to develop new strategies for turning in this new basin. There was adequate basin area for the pilots to avoid this problem and these particular runs are not considered indicative of future maneuvers. Plates 119 - 128, showing runs in flood conditions, indicate the problems which the pilots experienced in the original three turning basins were alleviated. It should be reiterated that these runs were conducted with a 33-ft draft, even-keel vessel, and as such represent fairly difficult conditions. Predominantly, ships will arrive with a shallower draft in preparation for loading at the McDuffie Terminal and thus will be easier to maneuver.

Pilot Scenario Ratings

During the simulation tests the pilots were asked to rate the difficulty of each scenario as they finished the runs. The rating scale given to them ranged from 0 to 10. A rating of 5 indicated that the difficulty of the simulation test just completed was what the pilot would expect based on his experience with navigation in the existing channel under the same set of environmental conditions. A rating less than 5 would indicate an easier run than expected compared to real existing conditions and a rating greater then 5 would indicate a more difficult run. The overall average pilot ratings for the tested turning basin configurations are shown below. These averages were based solely on turning basin plan and do not result from a data grouping according to scenario current condition.

Plan	Rating
Existing	5.0
Plan 1	6.1
Plan 2	6.5
Plan 3	7.1
Plan 4	5.7

The 5.0 rating for the existing channel constitutes a good validation of the simulation model in the study. The ratings of the proposed plans tend to agree with the conclusions and observations from the trackplots and tug usage plots.

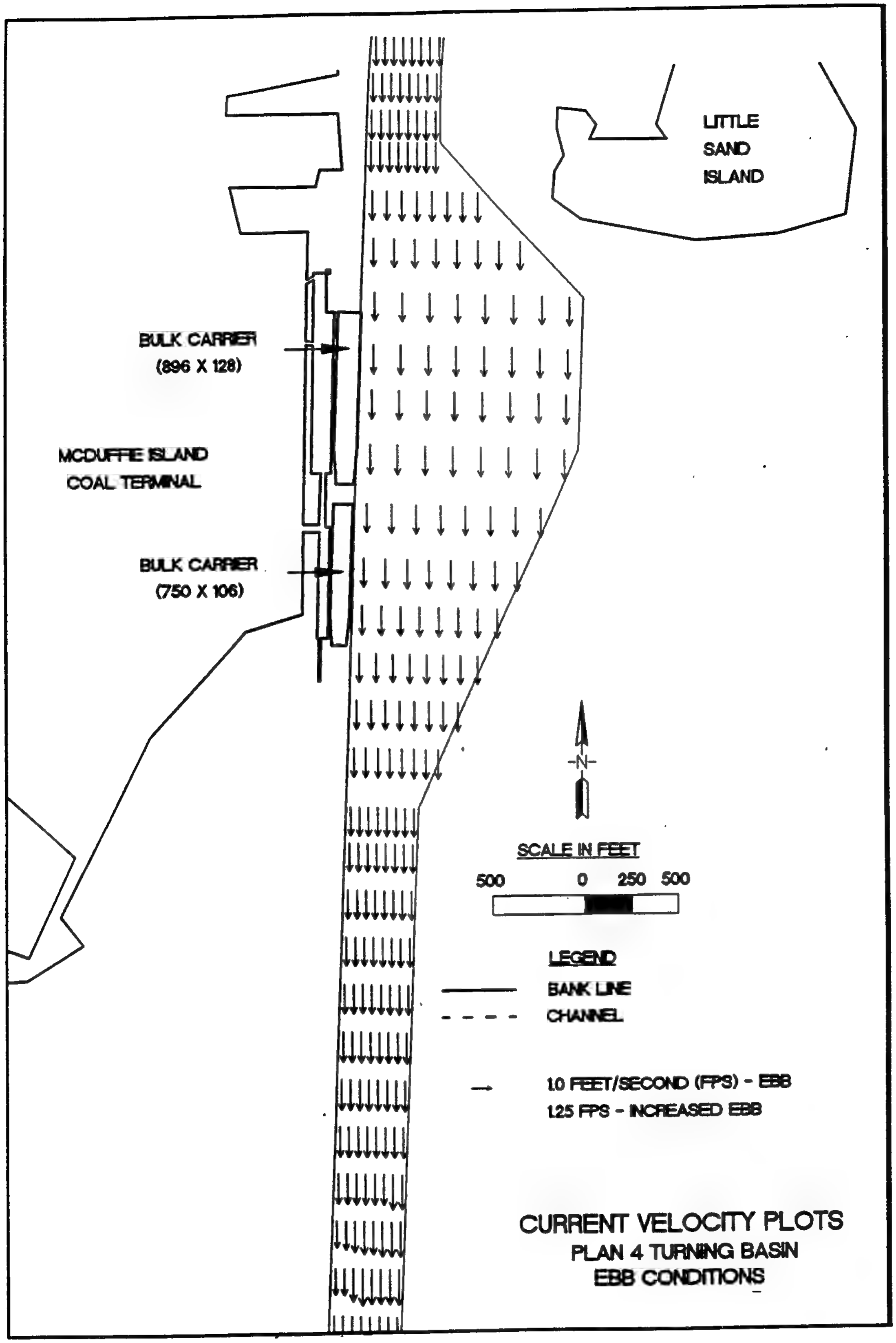

Figure 13. Plan 4 currents - Ebb tide

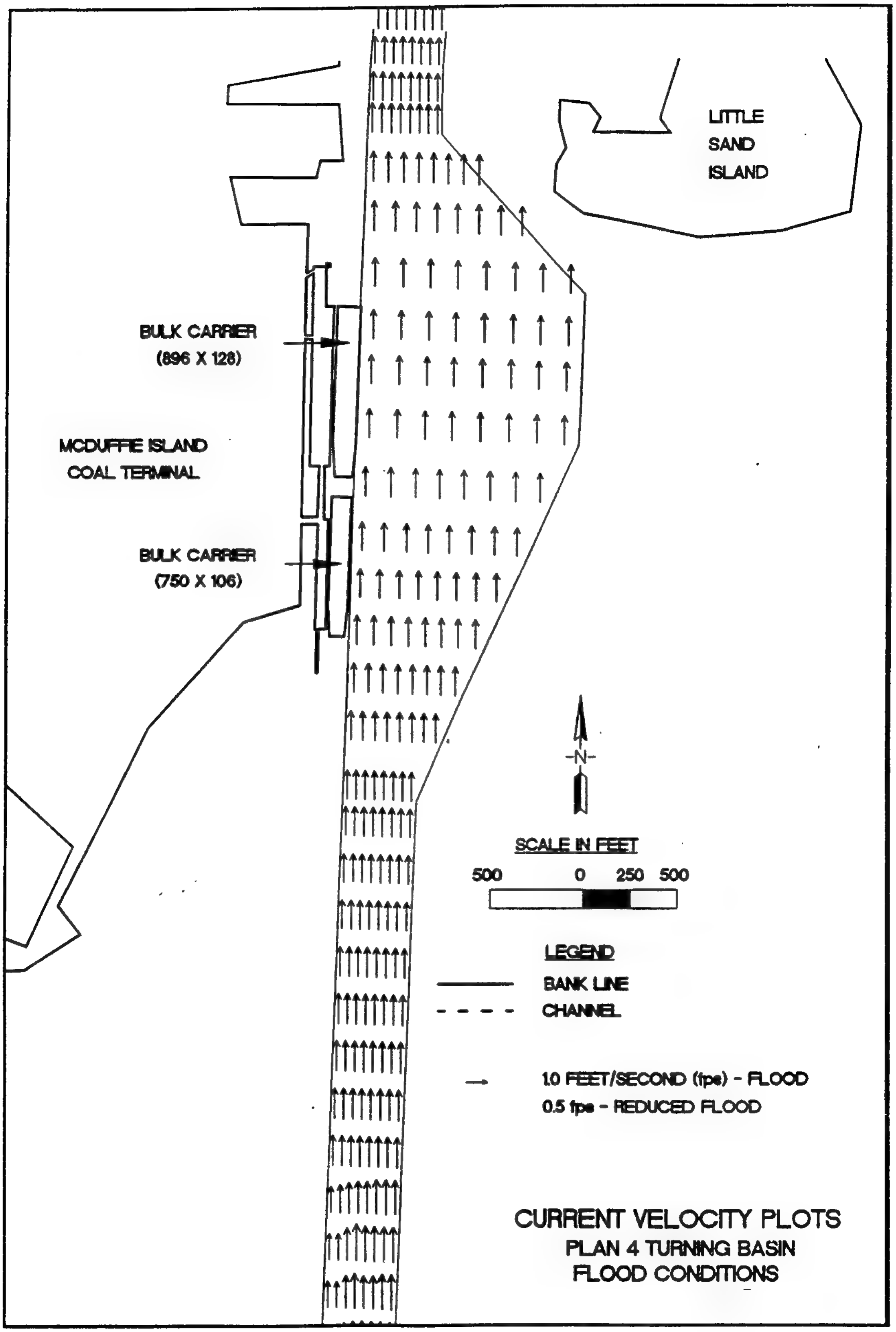

Figure 14. Plan 4 currents - Flood tide

4 Initial Test Set Conclusions

One important factor affecting the results of the simulation study was the off-limits status of the berthing areas at the McDuffie Island Coal Terminal. In the existing condition the pilots use this area to turn their vessels; however, during the proposed condition simulations use of this space for maneuvering was precluded. The pilots were restricted to maneuvering only in the proposed authorized basin.

Another factor affecting the simulation study was the equal status given to ebb and flood tide conditions. Northerly current flow (flood) in this area is much less frequent than southerly flow (ebb) because of the usual dominance of river flow over tidally driven flow. Flood tide conditions in the simulator were approximated by reversing the measured ebb flow: no actual flooding current data were obtained. Inclusion of this condition (compounded with southeasterly wind) had a great impact on these initial tests.

The design vessel used in the initial simulation tests represents the largest ship expected to call at the Port of Mobile. Most ships loading at the coal terminal are, and will be, smaller[1]. Using a smaller vessel in the simulation tests and accepting operational restrictions on 950-ft long vessels could result in different study conclusions.

Based on these tests, it was concluded that Plan 4 is the best basin design and is shown in greater detail on Figure 15. This plan generally moves the basin farther north in comparison to the Plan 1 proposal. This results in the recommended alignment coinciding more closely with existing deeper water which may alleviate dredging costs. It should be noted that simulation tests in Plan 4 are limited in number. Additional tests were recommended before final design with other pilots if Plan 4 proved economically feasible.

1 During 1989 approximately 7% of the vessel calls at McDuffie Terminal were at least 900 ft in length.

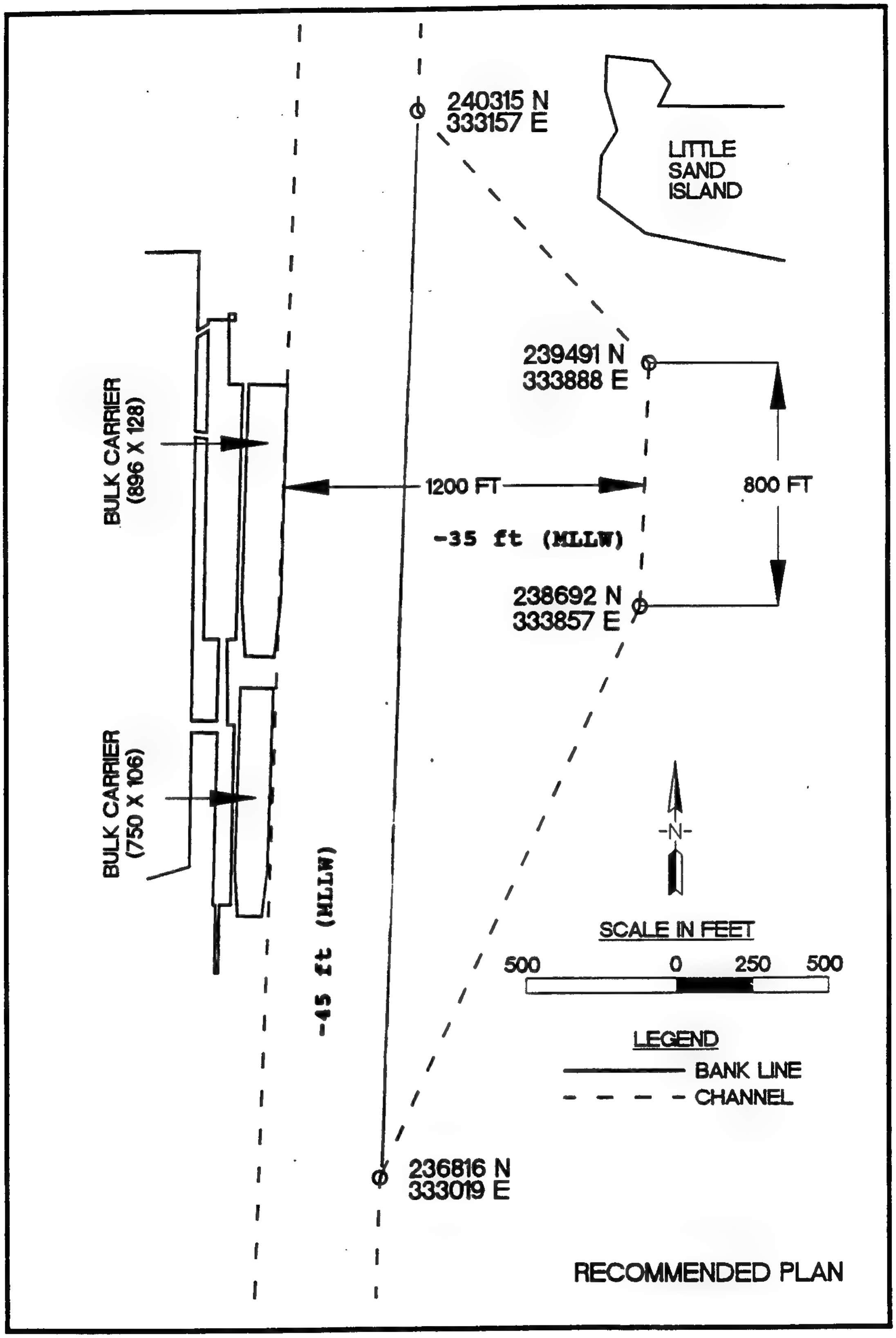

Figure 15. Recommended plan (original) (for Bulk Carrier 950′ x 145′ x 33′)

5 Additional Tests

Test Conditions

Subsequent to the original tests, the District requested that WES perform additional simulations reflecting modifications to design conditions[1]. The primary design change was to a smaller ship. The new design ship was a bulk carrier with an LOA of 858 ft, a beam of 134 ft and a trimmed draft of 29 ft at the stern and 21 ft at the bow (average draft of 25 ft). This particular design ship represents bulk carriers which call at the Port of Mobile on a frequent basis. Additional current data analysis by the District indicated that the magnitude of the flood currents used in the original tests was too high. The footnoted memorandum specified flood current speed to be 0.4 fps and ebb current speed to be 2.3 fps. These were the magnitudes used in the additional tests. The current directions remained the same as indicated on figures 9 - 12. Variations on two of the original proposed basins, Plan 2 and Plan 3 were used for the new tests. These were titled New Plan 2 and New Plan 3. Figure 16 shows the configurations of these test channels - the only change is in the water depth, which was reduced to -27 ft (MLLW).

Tugs

For the additional tests the same three 4000-hp (horse-power) tugs were used as in the original tests except that one of the tugs was restricted to only half power. This specification was based on comments by some of the pilots stating that three 4000-hp tugs are not available in Mobile at the present time. Another change in test conditions during the additional study was that it was possible on the simulator for the tugs to back directly alongside of the vessel. This feature was not available during the original set of runs. Using tugs in this fashion is common in many harbors when trying to stop a ship and maintain steerage. The tug-usage plots discussed below reflect this additional feature with the inclusion of longitudinal as well as lateral tug forces. During the original tests the pilots could only use tugs at right angles to the vessels.

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[1] CESAM-EN-YD MEMORANDUM FOR RECORD, 27 September 1993, subject: Mobile Harbor Turning Basin, Additional Simulation Tests.

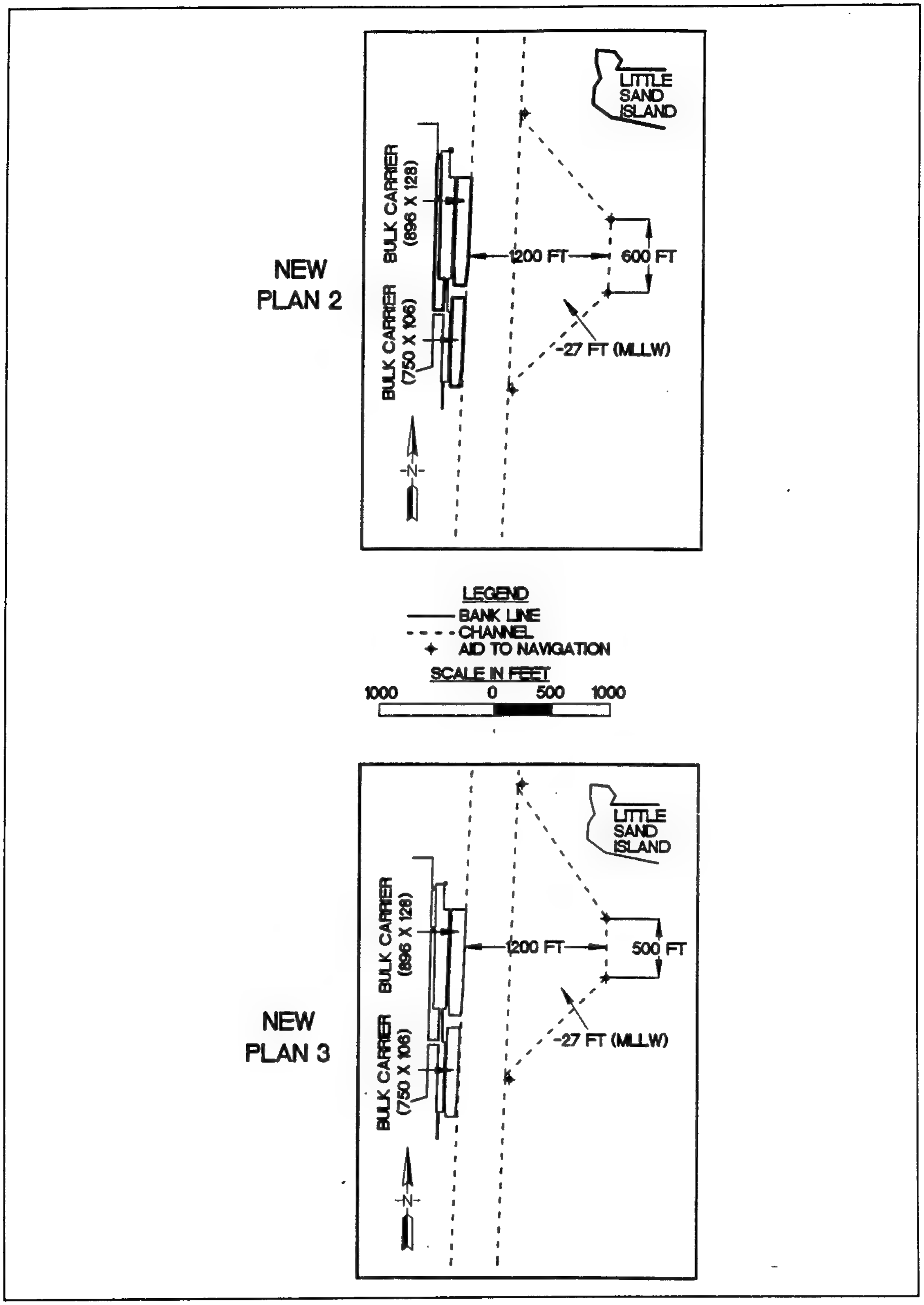


Figure 16. Add-on tests basin configurations

It is unlikely that the lack of the complete tug capability affected the study results in the original tests. By far the most significant change in the additional tests was the smaller vessel and lower currents.

6 Additional Test Results

Plates 147 - 212 show plotted results from the additional simulation tests. The last four plates show composite trackplots. The following two tables summarize the tests conducted during this part of the study.

New Plan 2 Scenarios - Plate Number Reference

			Trackplots		
Pilot	Ship	Current	Individual	Composite	Tugs
G	25 ft	Ebb	147	209	148
G (#2)	25 ft	Ebb	149	209	150
G	25 ft	Flood	151	210	152
G (#2)	25 ft	Flood	153	210	154
H	25 ft	Ebb	155	209	156
H (#2)	25 ft	Ebb	157	209	158
H	25 ft	Flood	159	210	160
H (#2)	25 ft	Flood	161	210	162
I	25 ft	Ebb	163	209	164
I (#2)	25 ft	Ebb	165	209	166
I	25 ft	Flood	167	210	168
I (#2)	25 ft	Flood	169	210	170
J	25 ft	Ebb	171	209	172
J (#2)	25 ft	Ebb	173	209	174
J	25 ft	Flood	175	210	176
J (#2)	25 ft	Flood	177	210	178

New Plan 3 Scenarios - Plate Number Reference					
			Trackplots		
Pilot	Ship	Current	Individual	Composite	Tugs
G	25 ft	Ebb	179	211	180
G (#2)	25 ft	Ebb	181	211	182
G	25 ft	Flood	183	212	184
G (#2)	25 ft	Flood	185	212	186
H	25 ft	Ebb	187	211	188
H (#2)	25 ft	Ebb	189	211	190
H	25 ft	Flood	191	212	192
I	25 ft	Ebb	193	211	194
I (#2)	25 ft	Ebb	195	211	196
I	25 ft	Flood	197	212	198
I (#2)	25 ft	Flood	199	212	200
J	25 ft	Ebb	201	211	202
J (#2)	25 ft	Ebb	203	211	204
J	25 ft	Flood	205	212	206
J (#2)	25 ft	Flood	207	212	208

Predominantly, the discussions made concerning the original tests also apply to the additional simulations. In a comparison between plates 209 and 210 (New Plan 2) and plates 211 and 212 (New Plan 3) showing composite trackplots the pilots were, generally, more successful in the New Plan 3 turning basin. This basin design is the farthest north of the two tested. Since the beginning of the simulation study most of the pilots have commented that the proposed basin should be as far north as possible. The test results tend to corroborate the pilots' opinions.

The New Plan 3 configuration could benefit from some modification. On Plate 211 for the ebb current conditions it can be seen that the northern corner of the basin is unusable. The northern corner is also not used for the flood current conditions (Plate 212) because the pilots turned the ships in the southern portion of the basin in anticipation of northward drift caused by the incoming tide. It is evident in both Plates 211 and 212 that the southern entrance to the basin is too restricted. The pilots cannot enter the basin far enough away from the docked ships to start an earlier turn. These two problems can be remedied with fairly small modifications to the basic design.

Figure 17 shows the final recommended turning basin configuration. The angle of the northern edge is flattened by moving the corner 200 ft to the

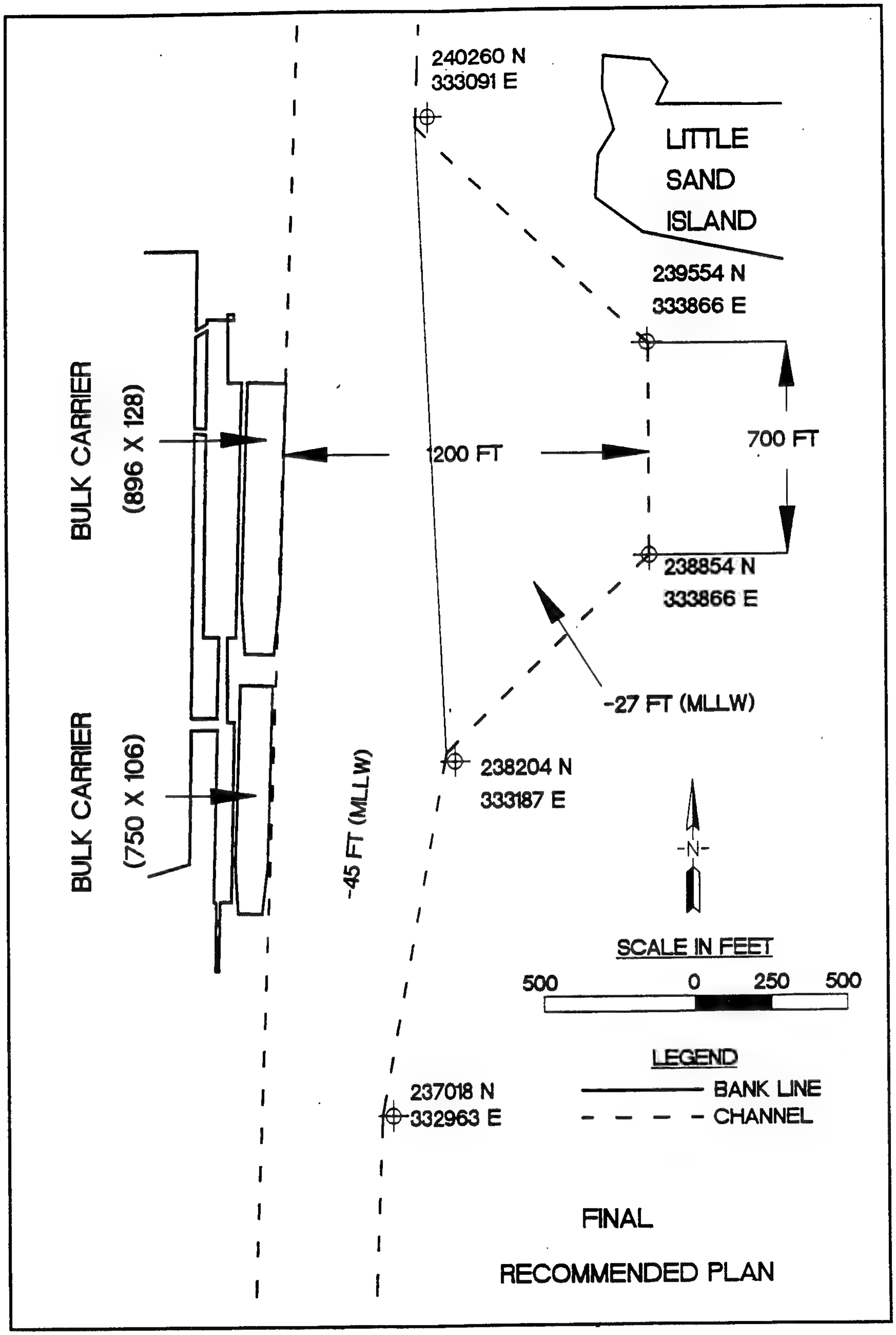


Figure 17. Final recommended plan (for Bulk Carrier - 858' x 134' x 29'/21')

south and lengthening the eastern edge (back of turning basin) to 700 ft. This results in approximately no net gain of basin area. At the southern corner the recommendation calls for the inclusion of an additional widened wedge resulting in an extra 150 ft of channel width opposite the southern end of the coal terminal. This wedge would need to be deepened to the -45-ft (MLLW) project depth since it will essentially be part of the main channel. The precise position of the toe of the slope between the -45-ft and -27-ft project depths is not specified. Consideration must be given to allowing adequate underkeel clearance for trimmed vessels such as the one tested. It is evident on many of the individual trackplots for the additional tests that the vessel ended the run with its stern (29-ft draft) in a position outside the main -45 ft channel. This was not considered significant because in most of these cases the stern would be within the slope zone. Figure 17 shows a toe-of-the-slope location which seems to be the most logical one given the recommended widened wedge at the southern entrance to the basin. With a constructed and maintained underwater 1V:5H slope between the recommended basin and Little Sand Island, erosion of the island itself is not anticipated.

7 Final Conclusions and Recommendations

Conclusions

The main conclusions of the simulation study are as follows:

a. When approaching the turning basin area pilots need to enter as far to the east as possible to allow room for their ship's stern to clear the berthing area at the southern end of McDuffie Terminal.

b. The main part of the turning basin needs to be as far north as possible.

c. Plan 4 (figure 15) was the best plan tested for the larger 950-ft long bulk carrier.

d. New Plan 3 (figure 16) was the best plan tested for the 858-ft bulk carrier.

e. New Plan 3 requires some modifications for the safe and efficient maneuvering of the 858-ft bulk carrier.

Recommendations

Study recommendations are as follows:

a. Recommend Plan 4 (figure 15) for the 950' x 145' x 33' bulk carrier design vessel.

b. Recommend the plan shown on figure 17 for the 858' x 134' x 25' bulk carrier design vessel.

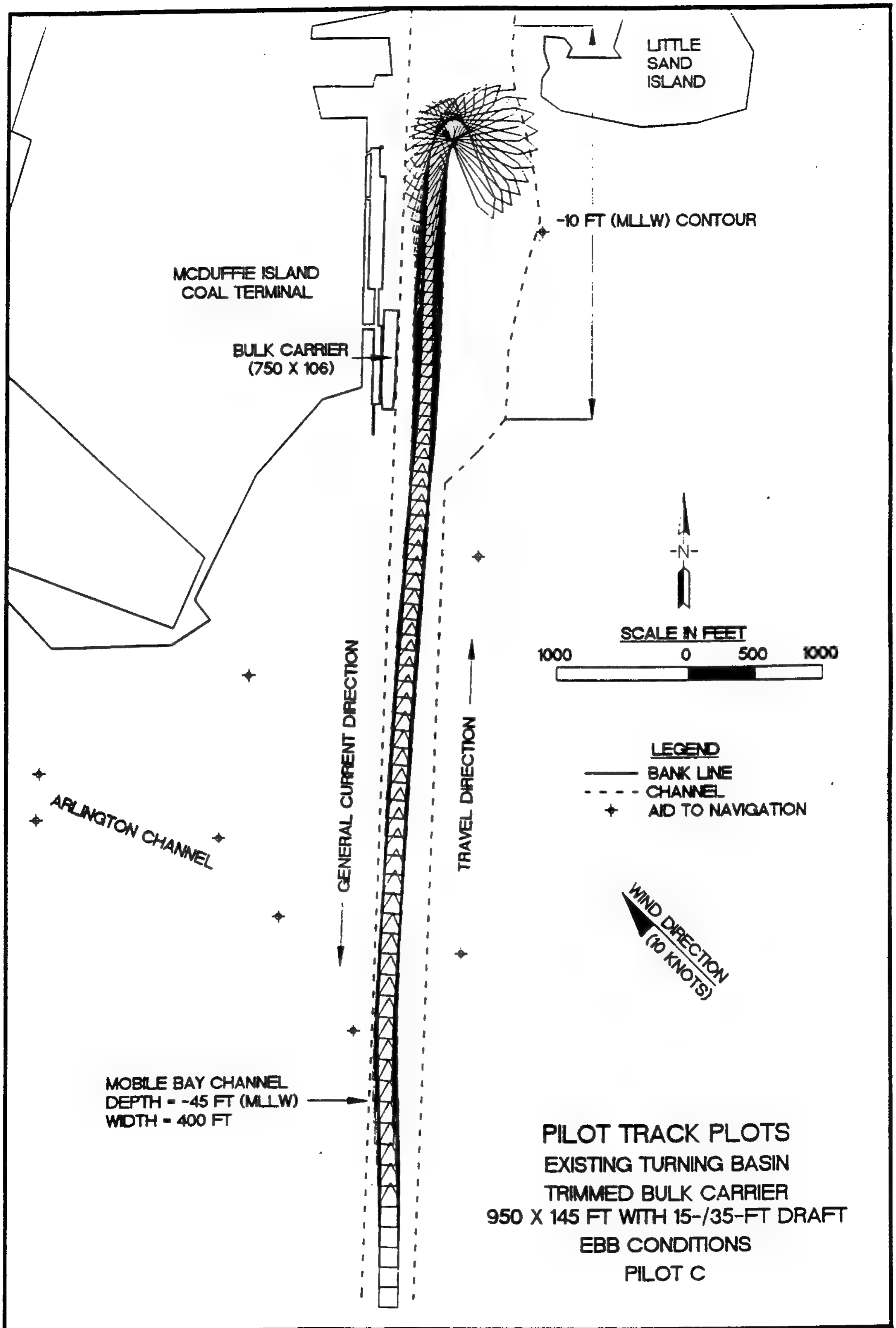
References

Lawing, R. J., Boland, R. A. and Bobb, W. H. (1975). "Mobile Bay model study, Report 1," Technical Report H-75-13, U.S. Army Engineer Waterways Experiment Station, Hydraulics Laboratory, Vicksburg, MS.

Berger, R. C. and Boland, R. A. (1979). "Mobile Bay model study, Report 2," Technical Report H-75-13, U.S. Army Engineer Waterways Experiment Station, Hydraulics Laboratory, Vicksburg, MS.

Huval, C. J. (1985). "Ship navigation simulator study upper Mobile Bay channel," Miscellaneous Paper HL-85-7, U.S. Army Engineer Waterways Experiment Station, Hydraulics Laboratory, Vicksburg, MS

Existing Channel Results



LITTLE
SAND
ISLAND
-10 FT (MLLW) CONTOUR
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
EXISTING TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
EBB CONDITIONS
PILOT C

Plate 1

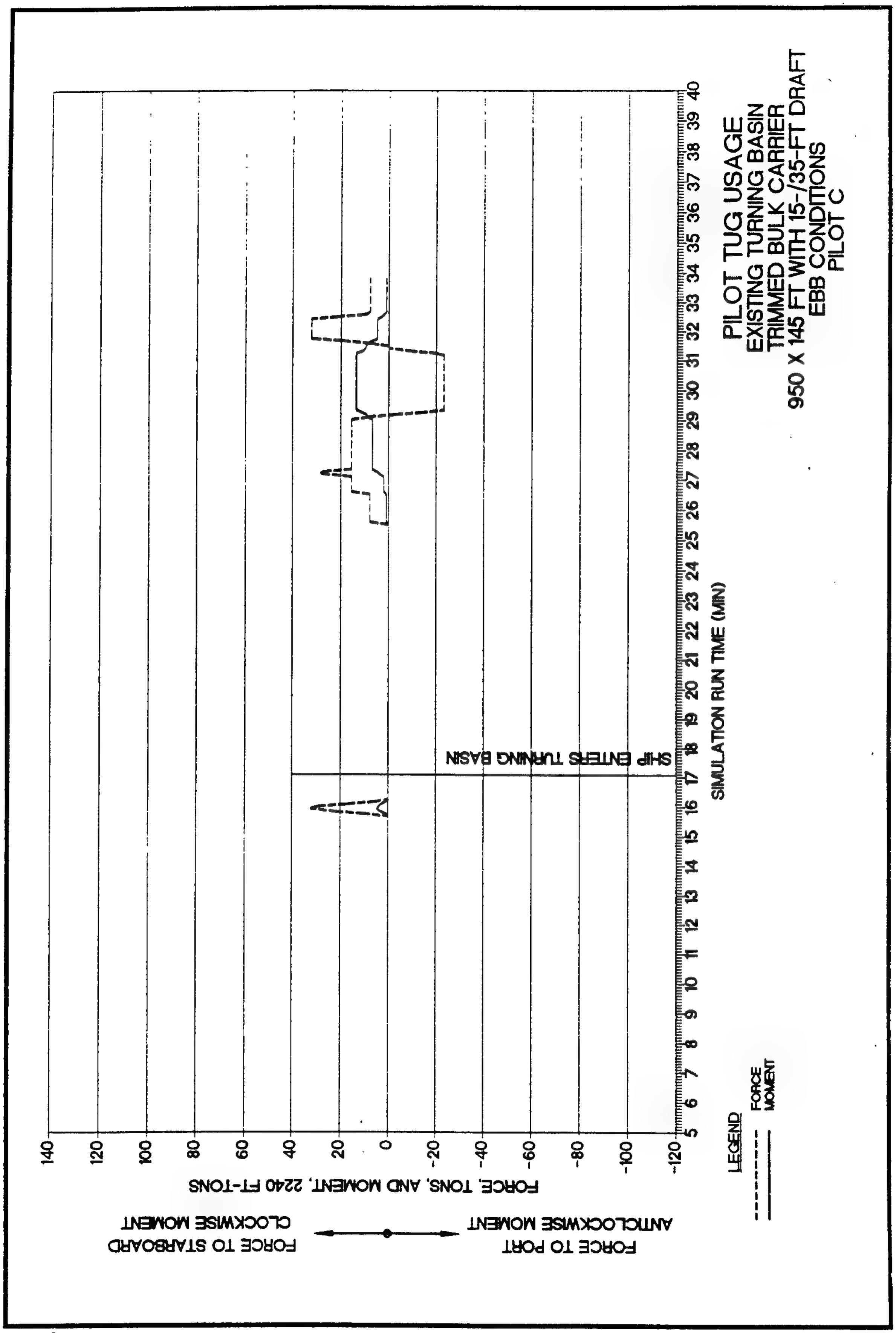
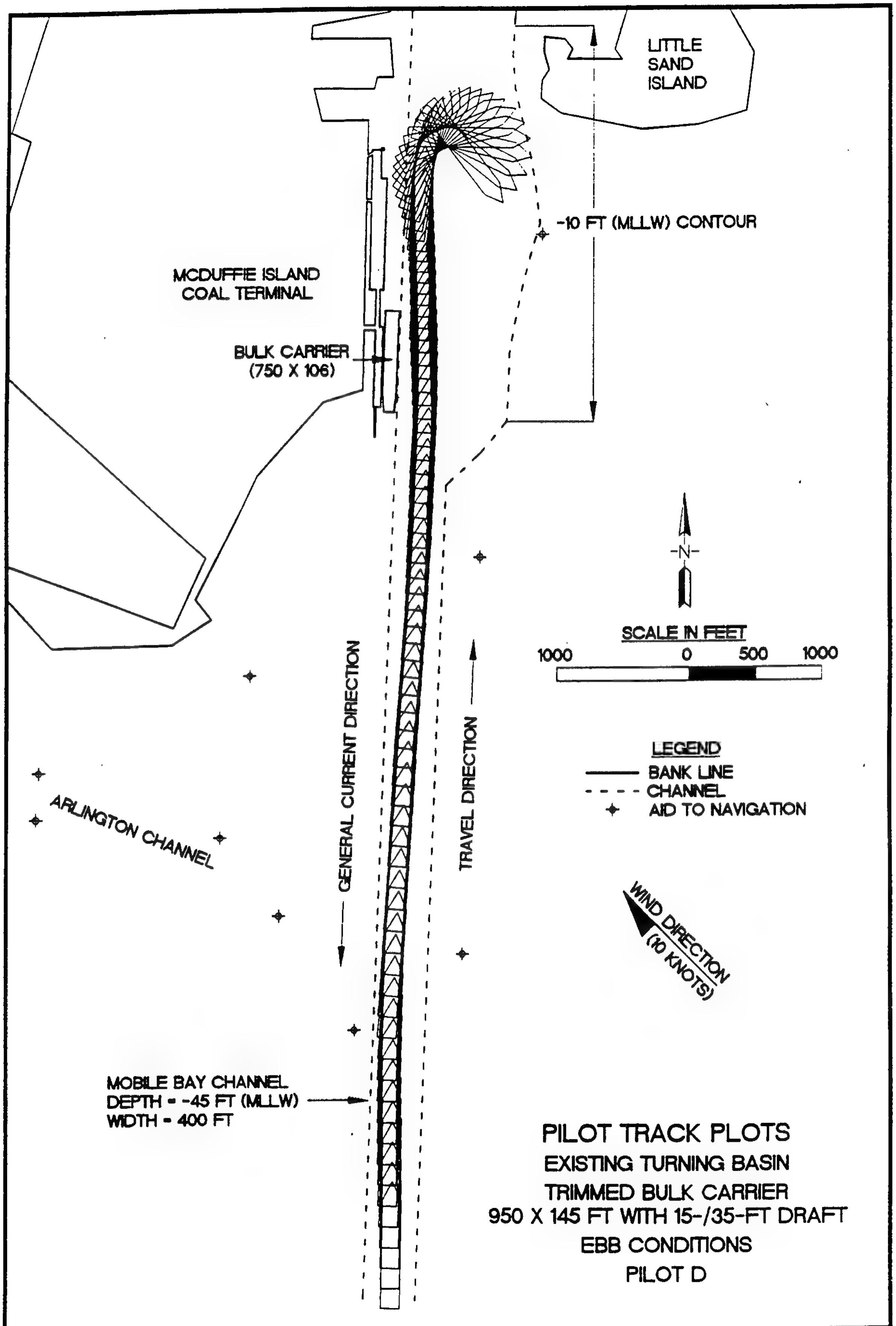

PILOT TUG USAGE
EXISTING TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
EBB CONDITIONS
PILOT C
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
SHIP ENTERS TURNING BASIN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
LEGEND
FORCE
MOMENT

Plate 2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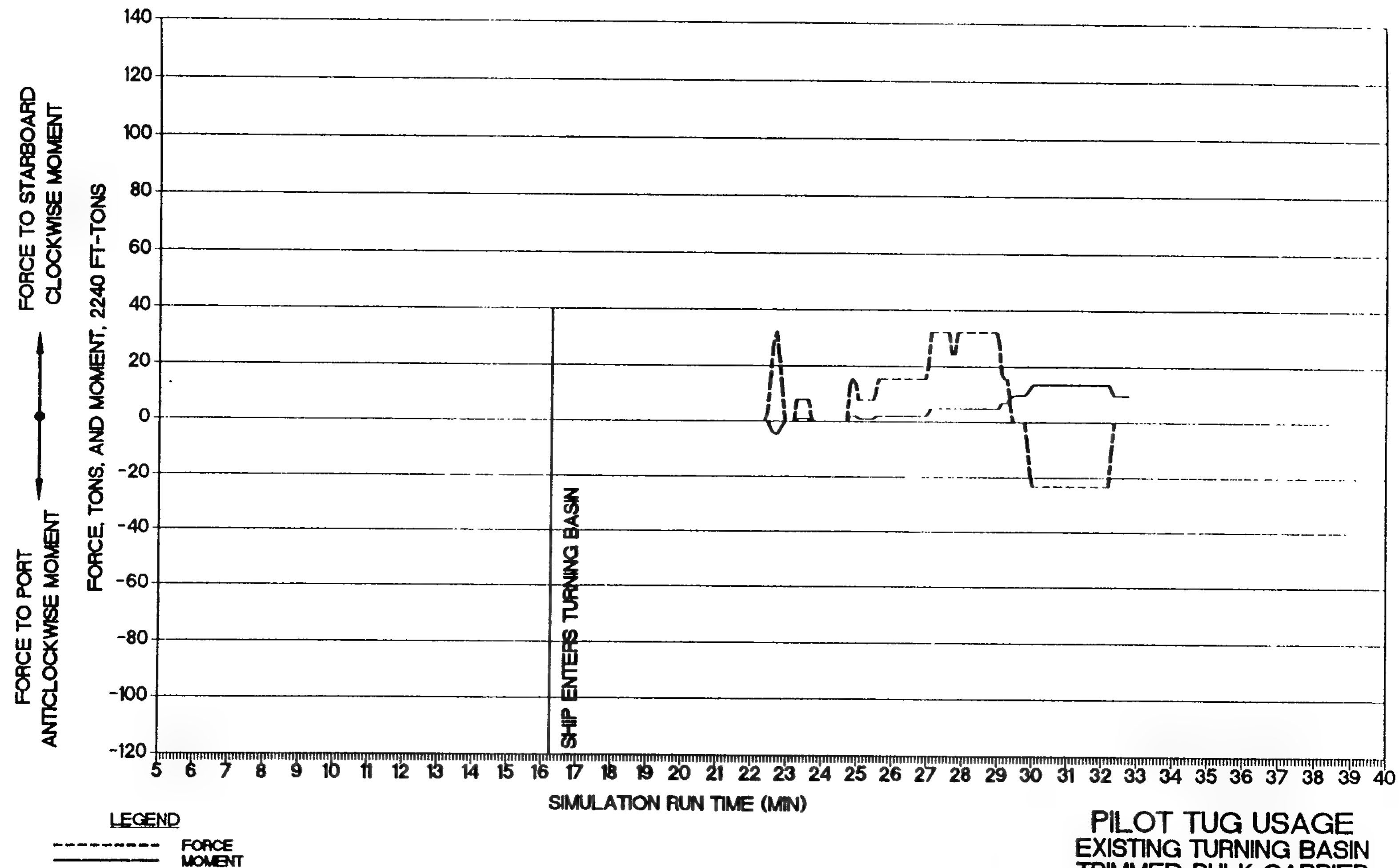
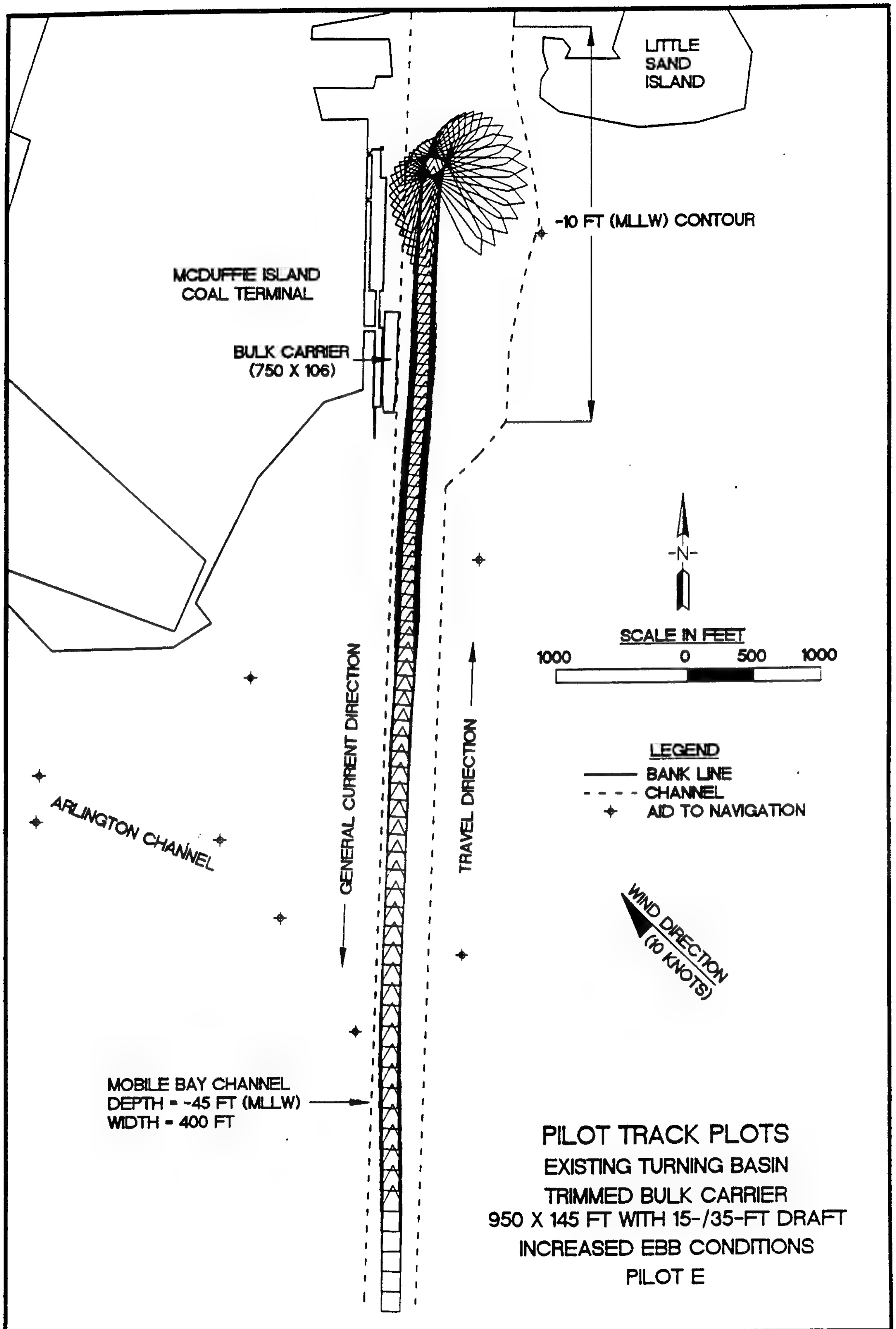
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
EXISTING TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
EBB CONDITIONS
PILOT D

Plate 3



PILOT TUG USAGE
EXISTING TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
EBB CONDITIONS
PILOT D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MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
SCALE IN FEET
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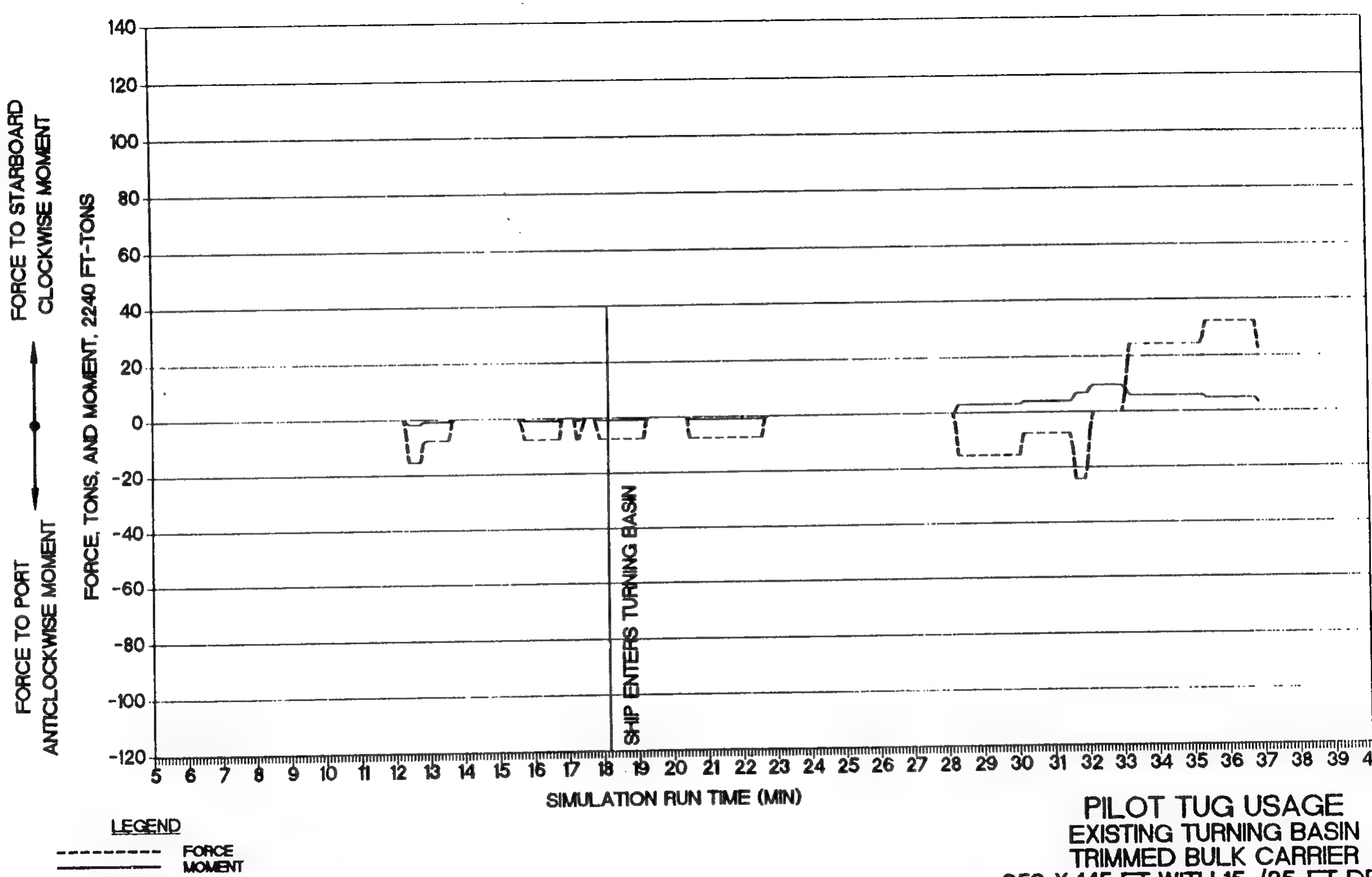
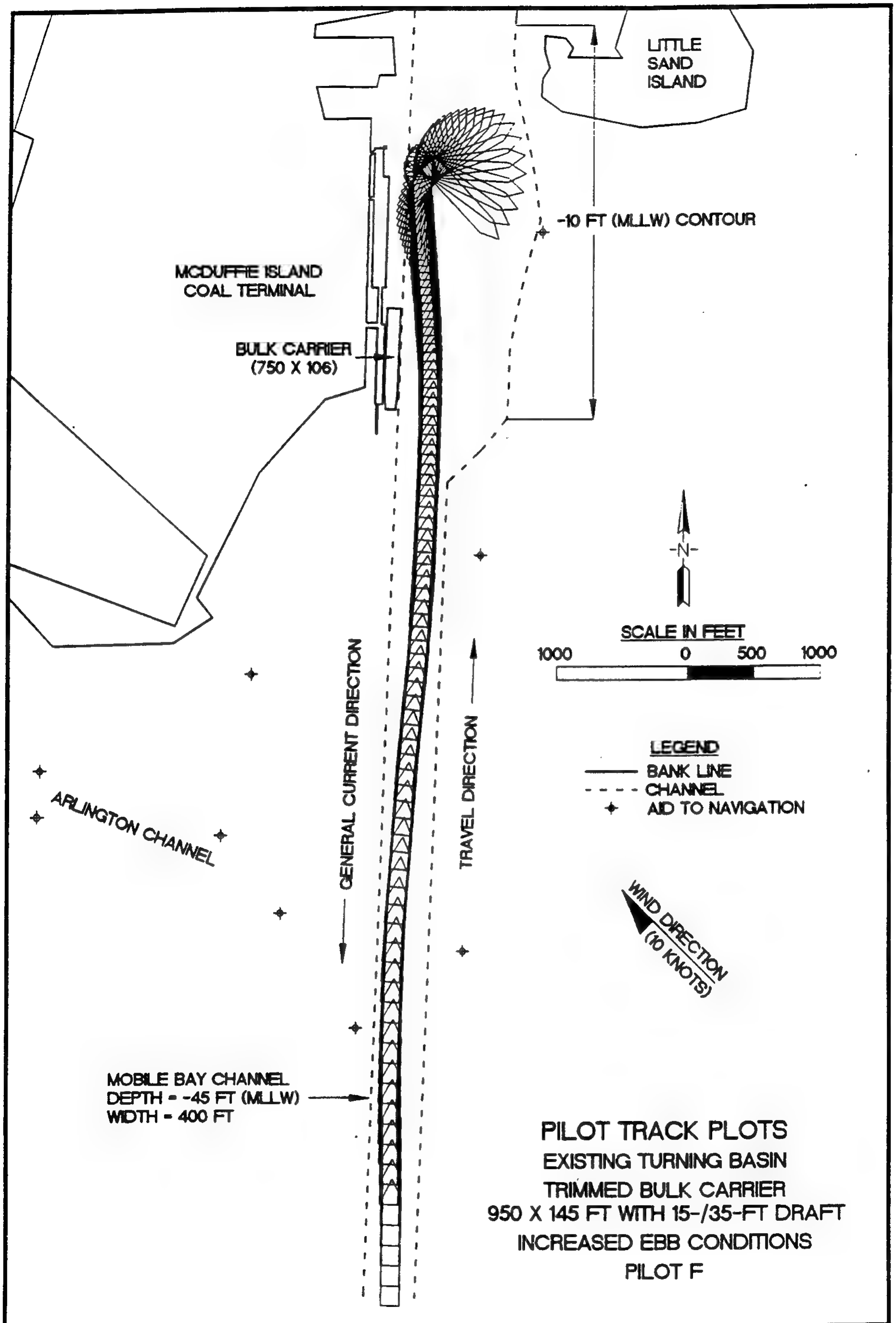
500
1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
EXISTING TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
PILOT E

Plate 5



PILOT TUG USAGE
EXISTING TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
PILOT E

Plate 6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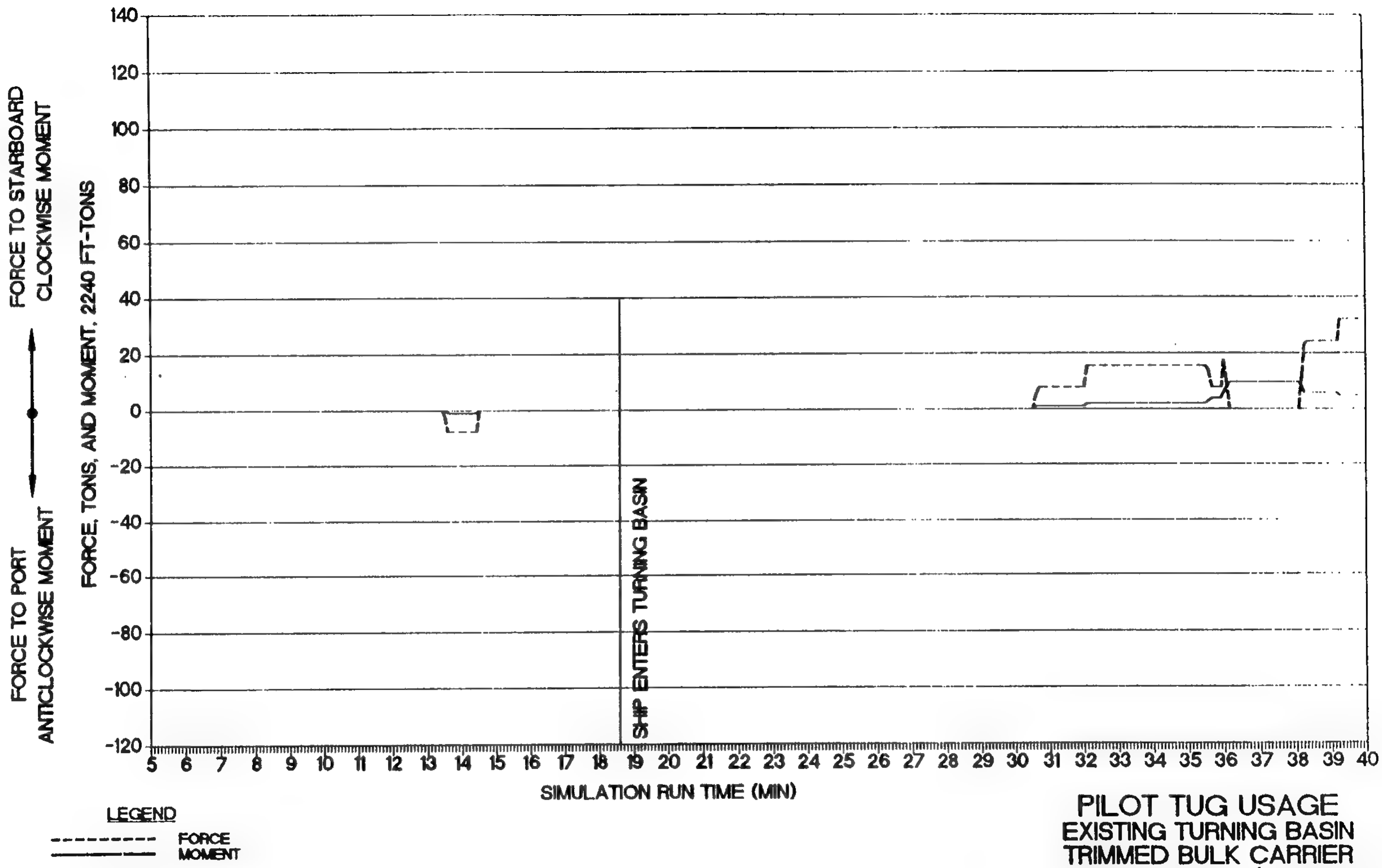
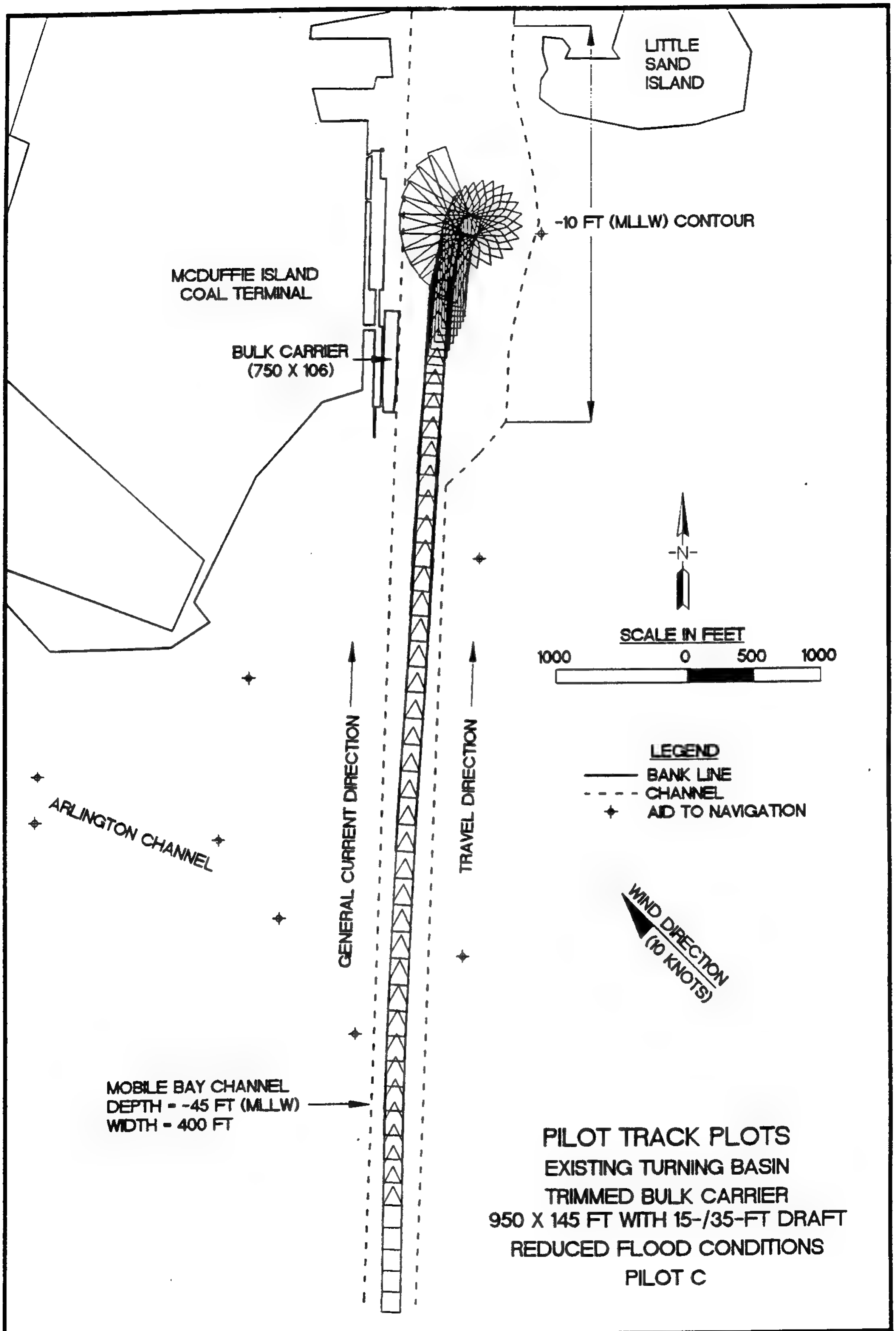
SAND
ISLAND
-10 FT (MLLW) CONTOUR
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
N
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
EXISTING TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
PILOT F



PILOT TUG USAGE
EXISTING TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
PILOT F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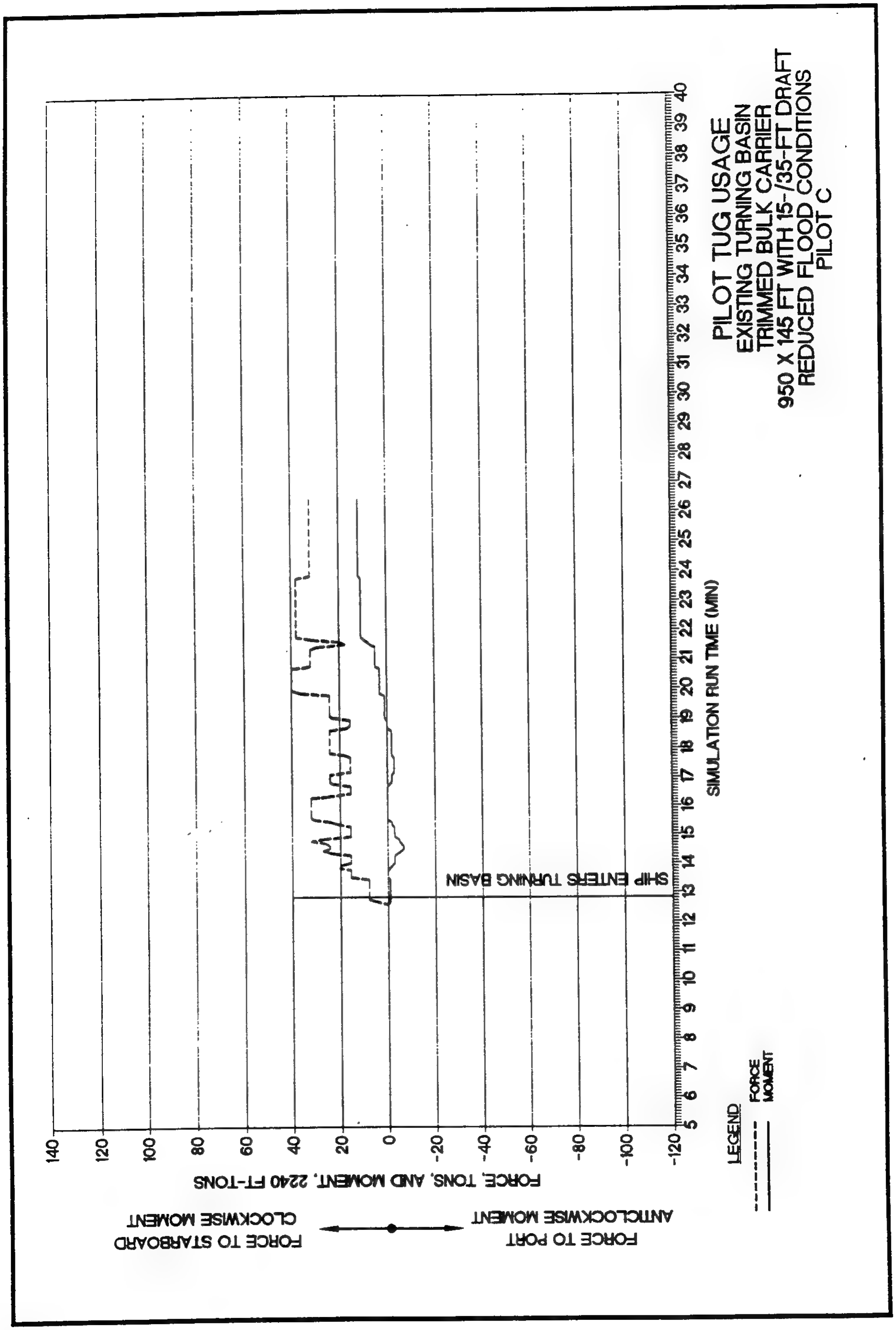
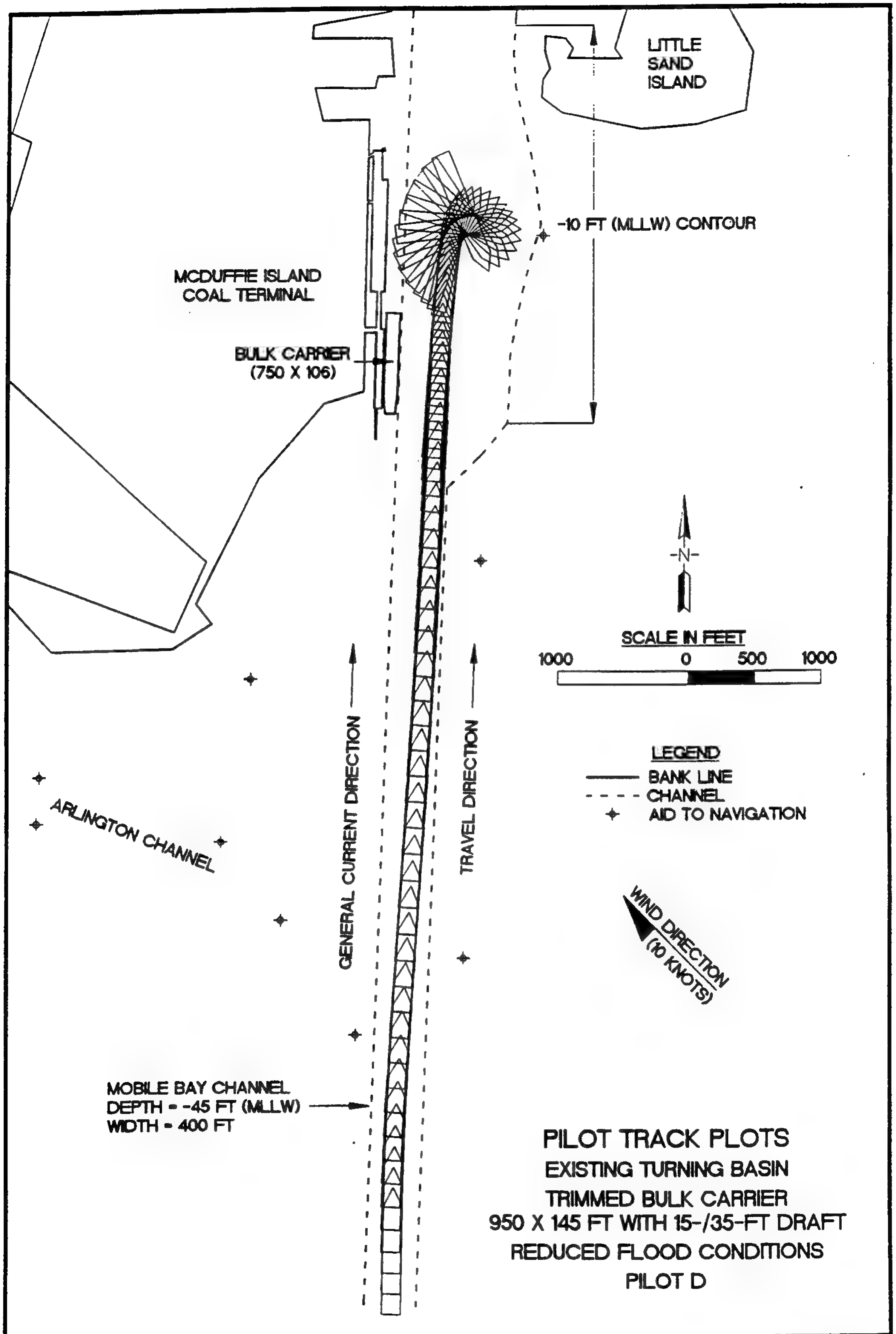
SAND
ISLAND
-10 FT (MLLW) CONTOUR
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
N
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
EXISTING TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT C

Plate 9


PILOT TUG USAGE
EXISTING TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT C
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
SHIP ENTERS TURNING BASIN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
LEGEND
FORCE
MOMENT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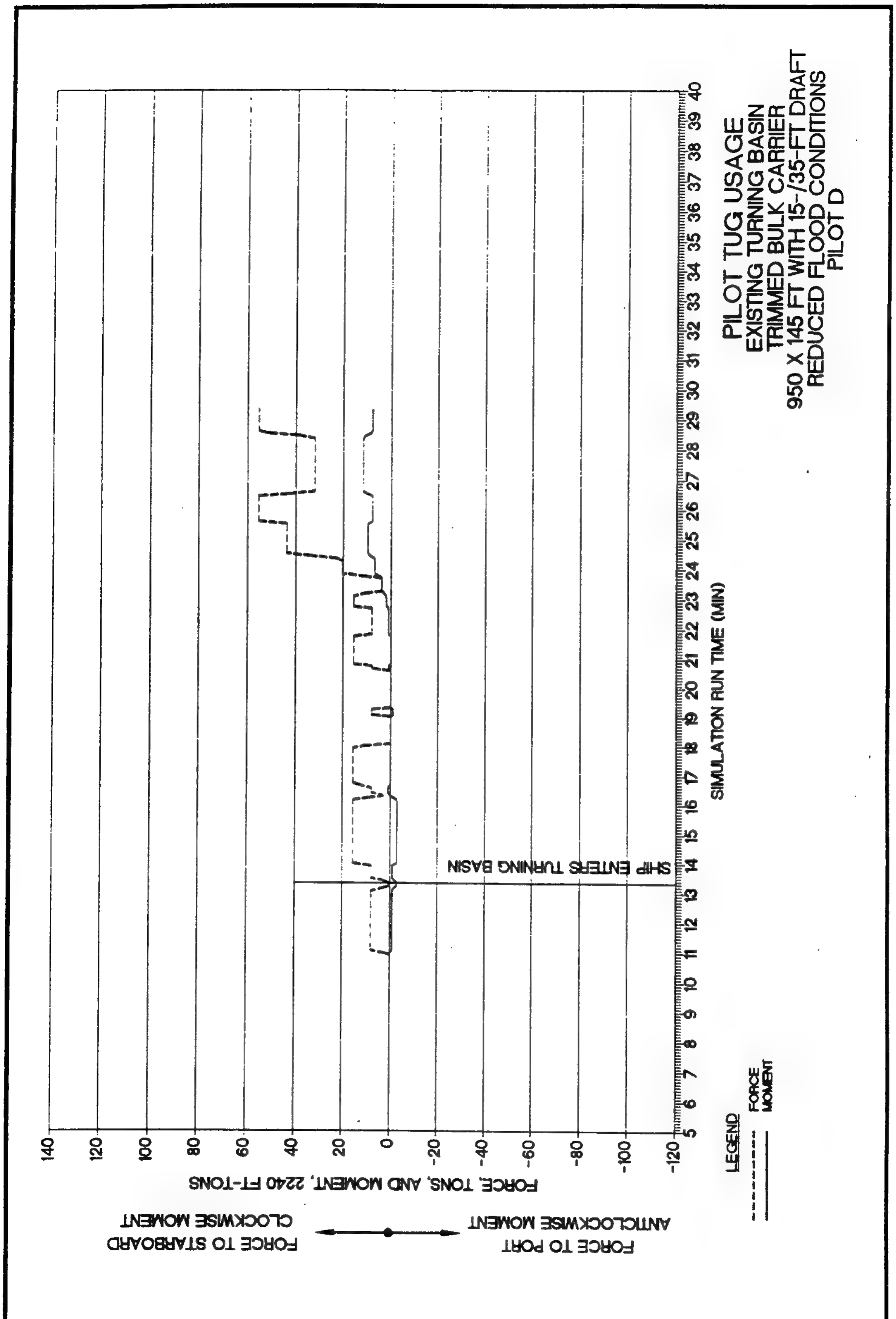
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
EXISTING TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT D

Plate 11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TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT D
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
SHIP ENTERS TURNING BASIN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
LEGEND
FORCE
MOMENT
140
120
100
80
60
40
20
0
-20
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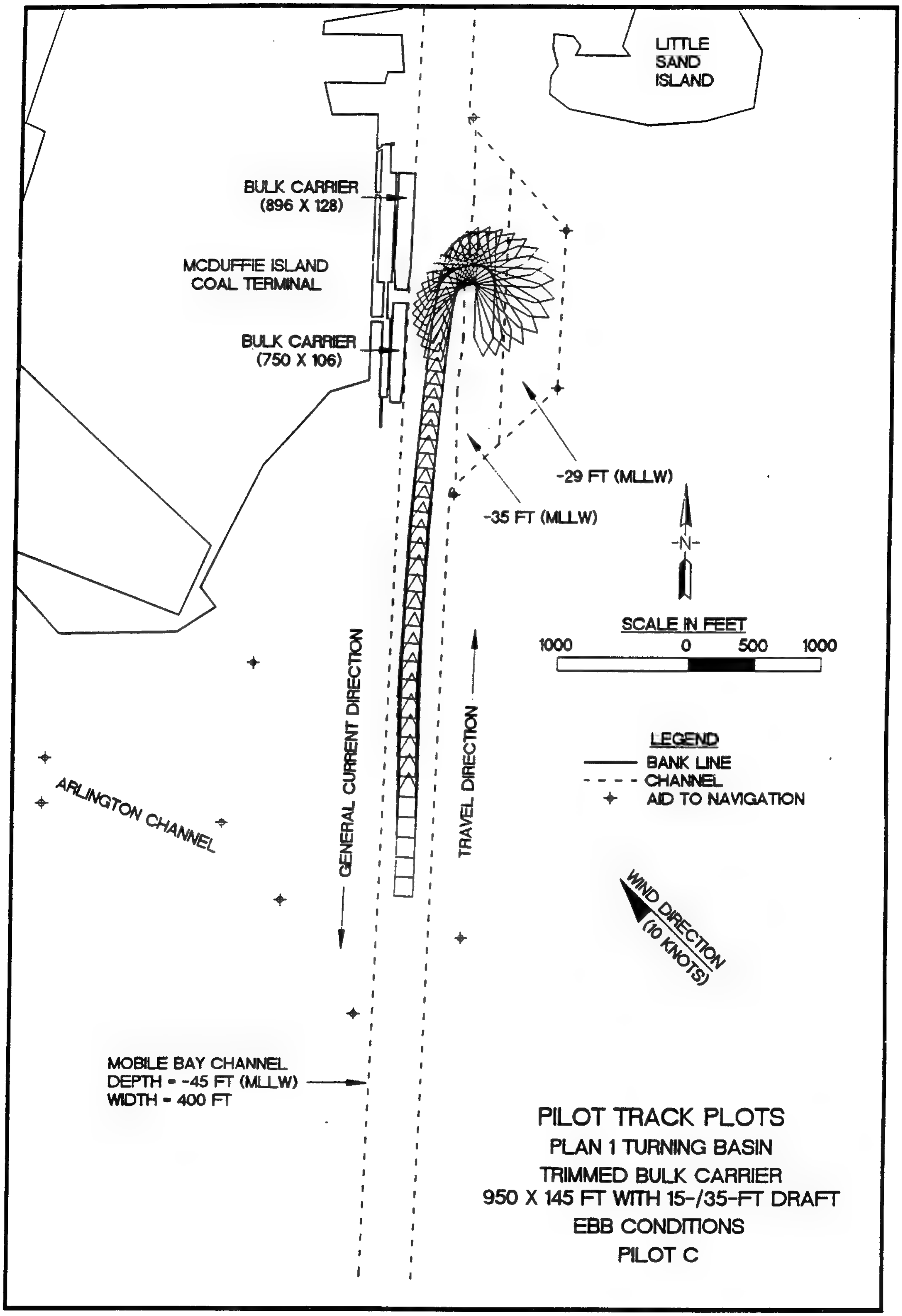
Plan 1 Results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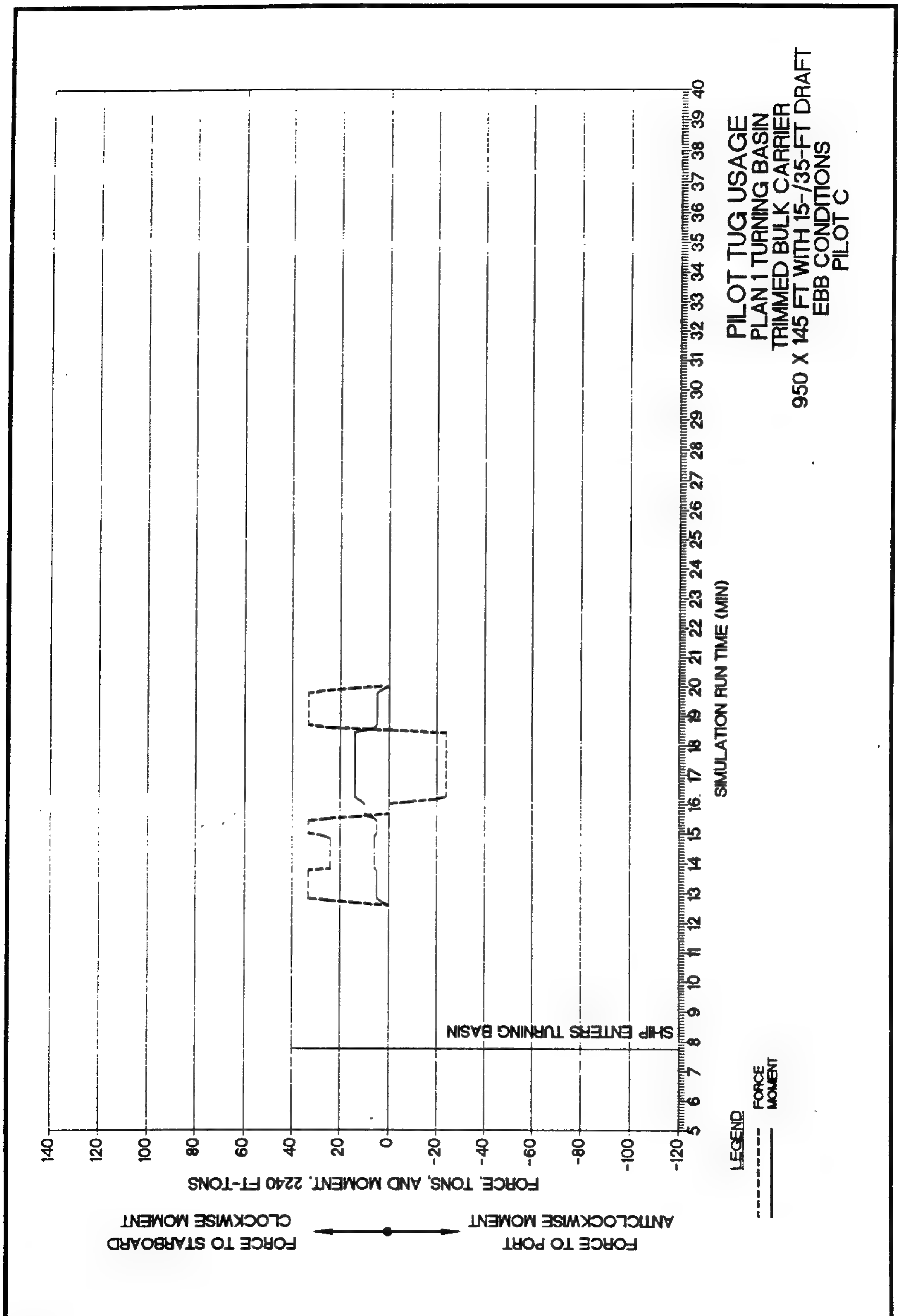
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-29 FT (MLLW)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
EBB CONDITIONS
PILOT C



PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
EBB CONDITIONS
PILOT C
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
SHIP ENTERS TURNING BASIN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
LEGEND
FORCE
MOMENT
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120
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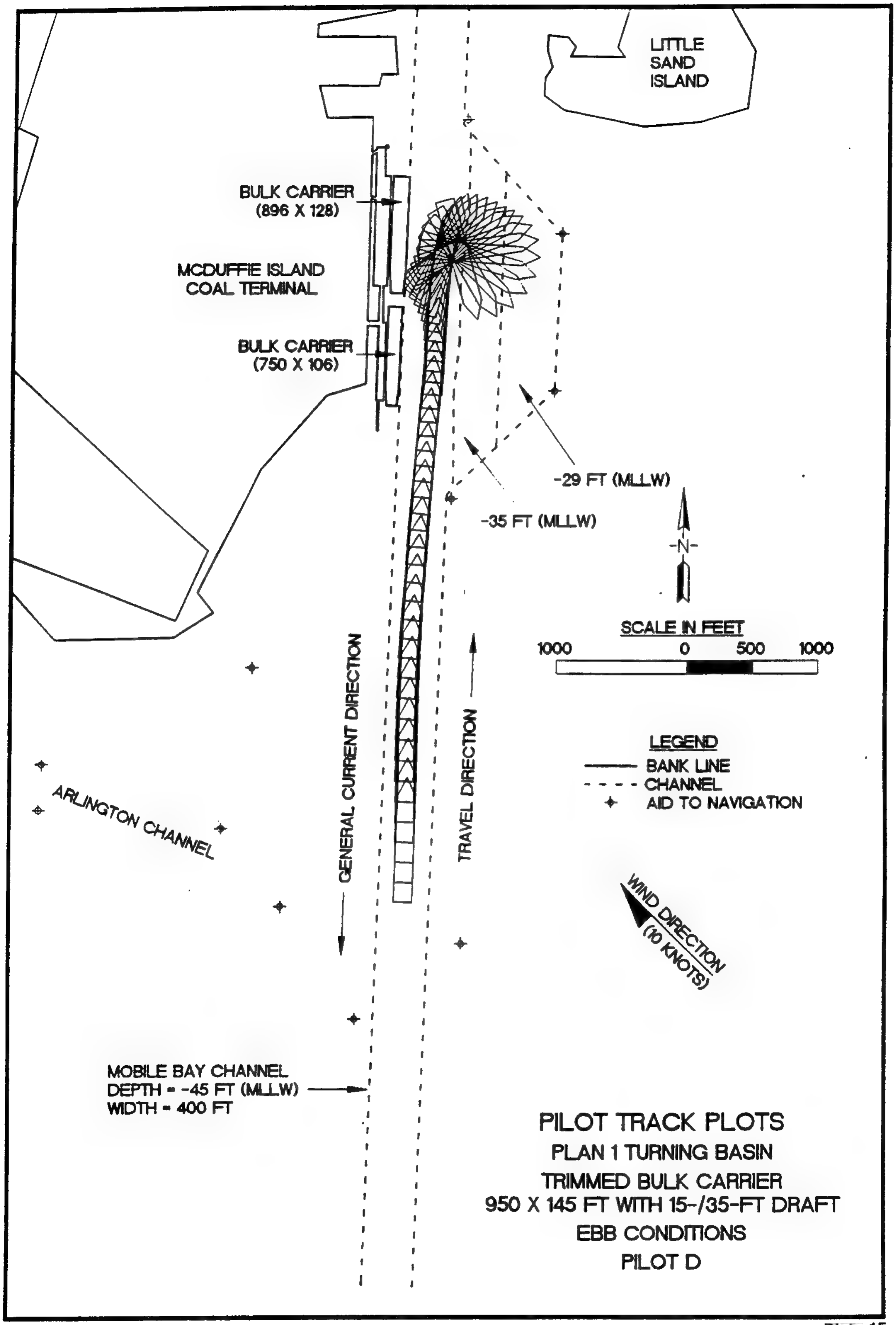
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-35 FT (MLLW)
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GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
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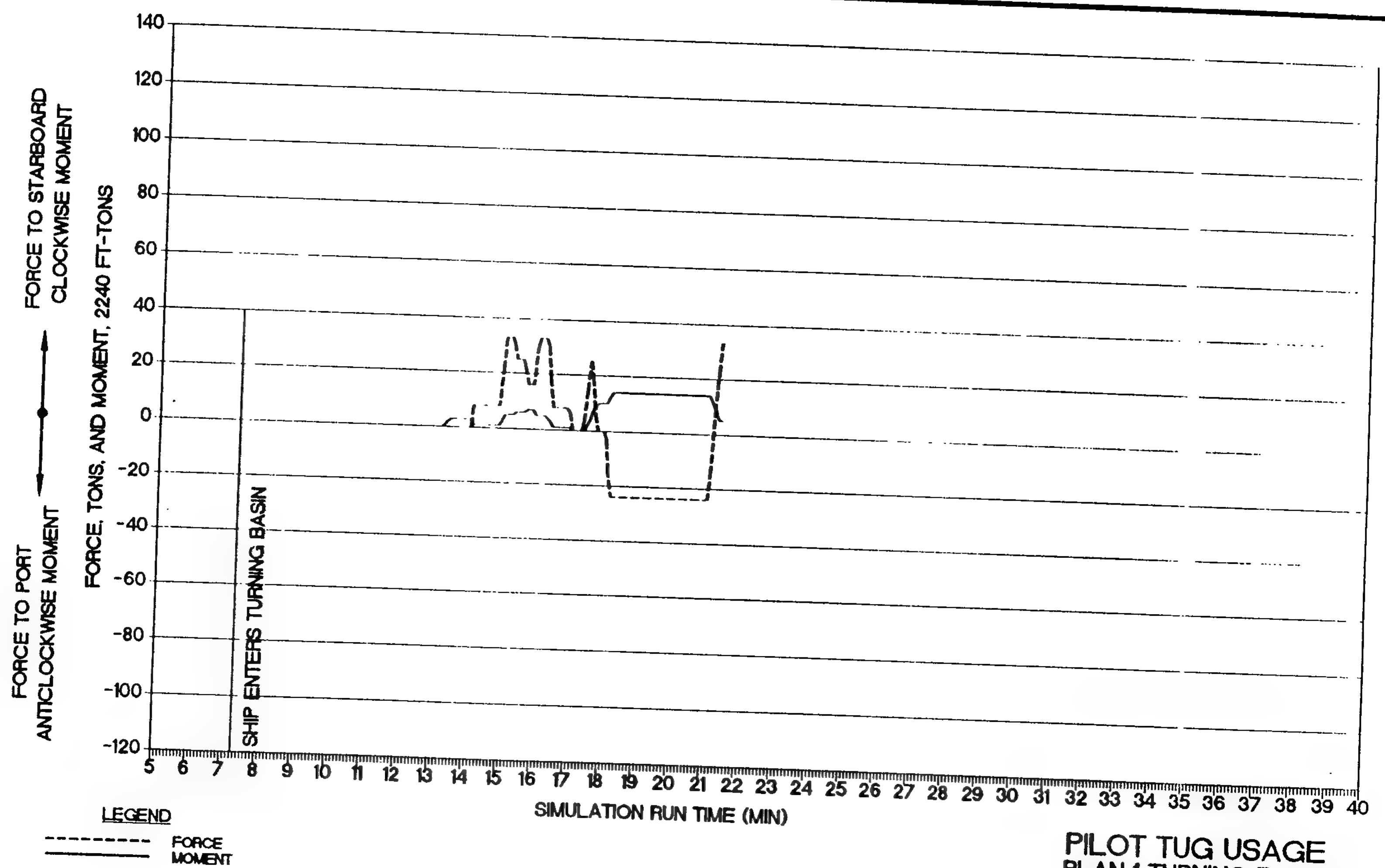
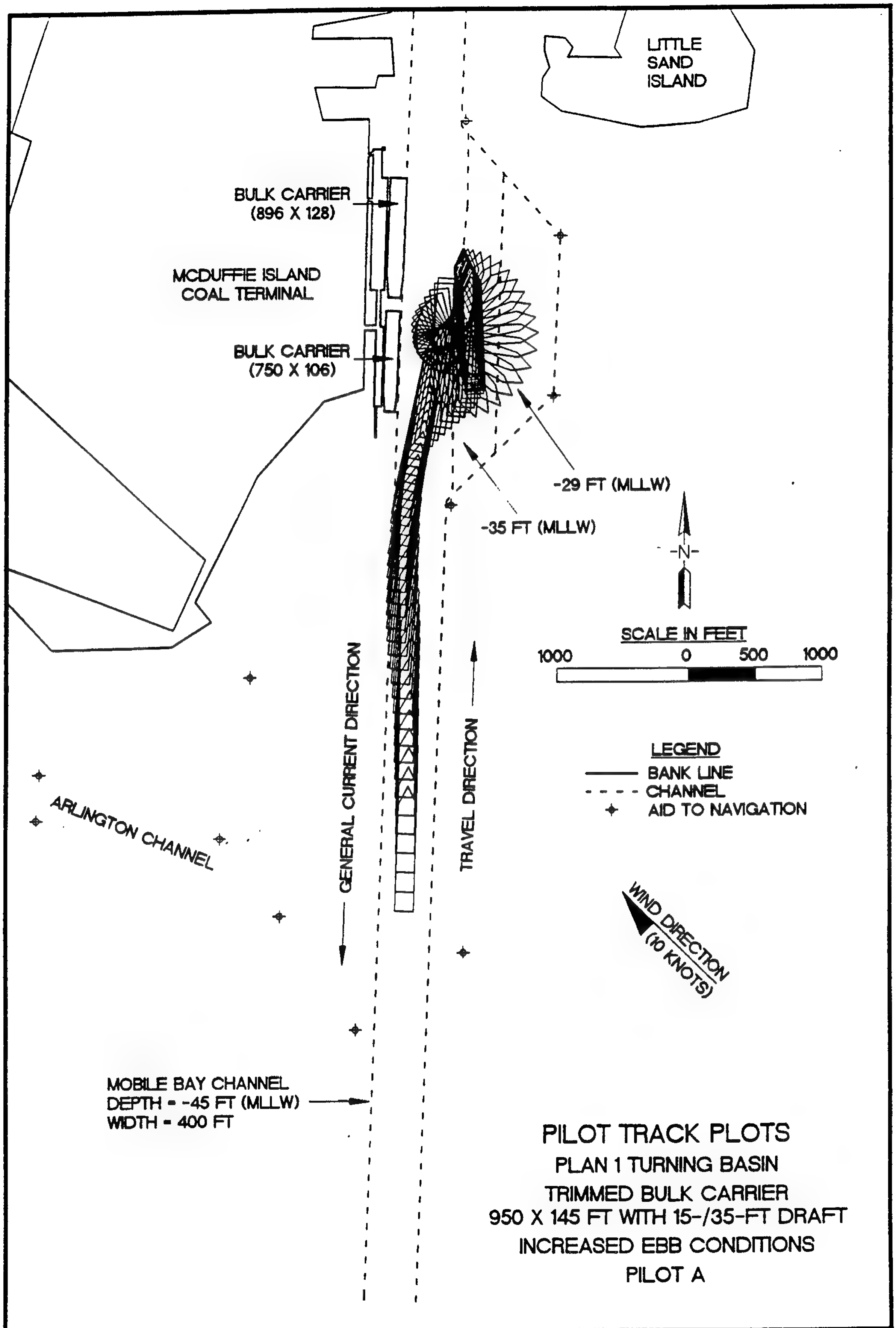
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
EBB CONDITIONS
PILOT D



PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
EBB CONDITIONS
PILOT D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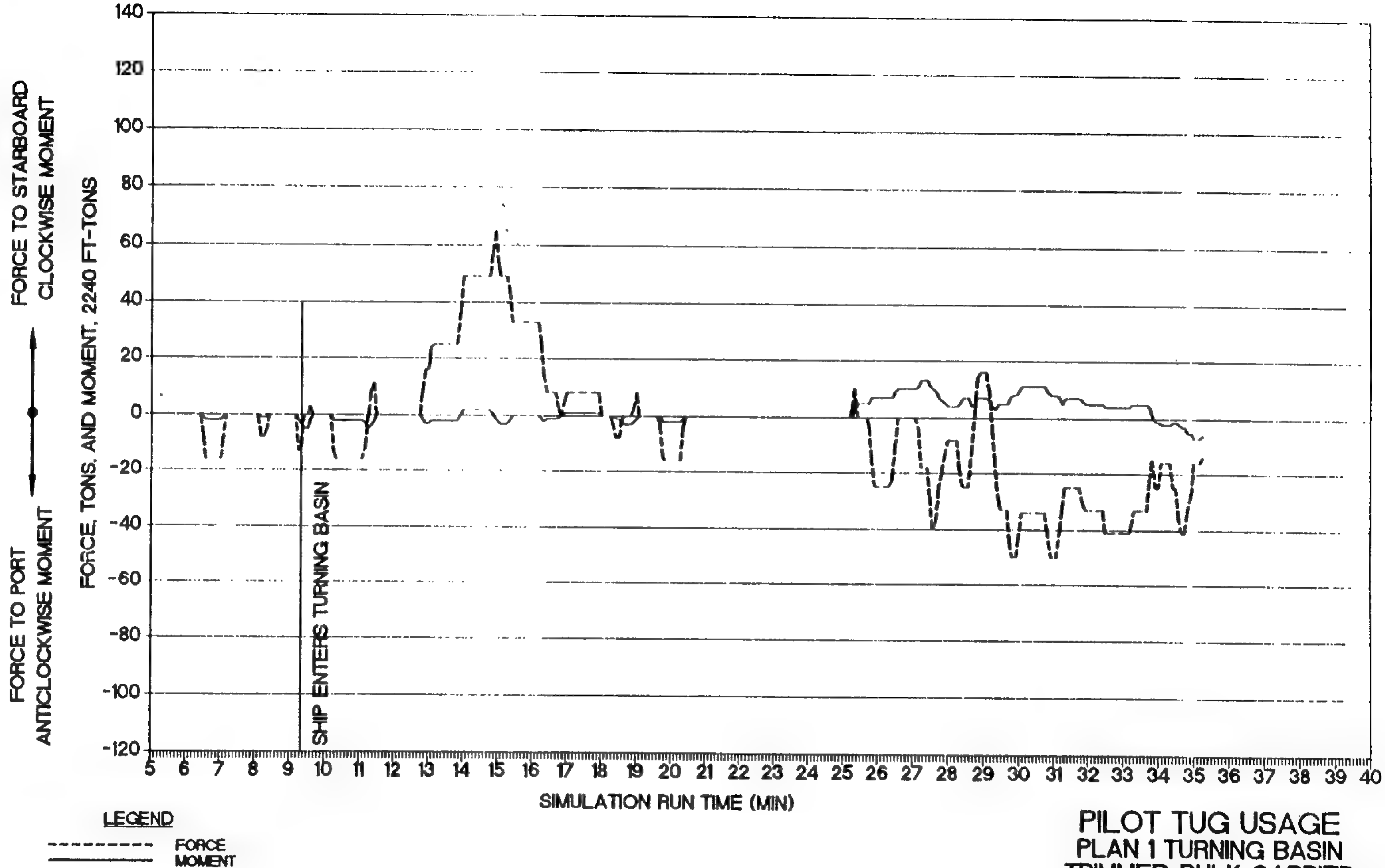
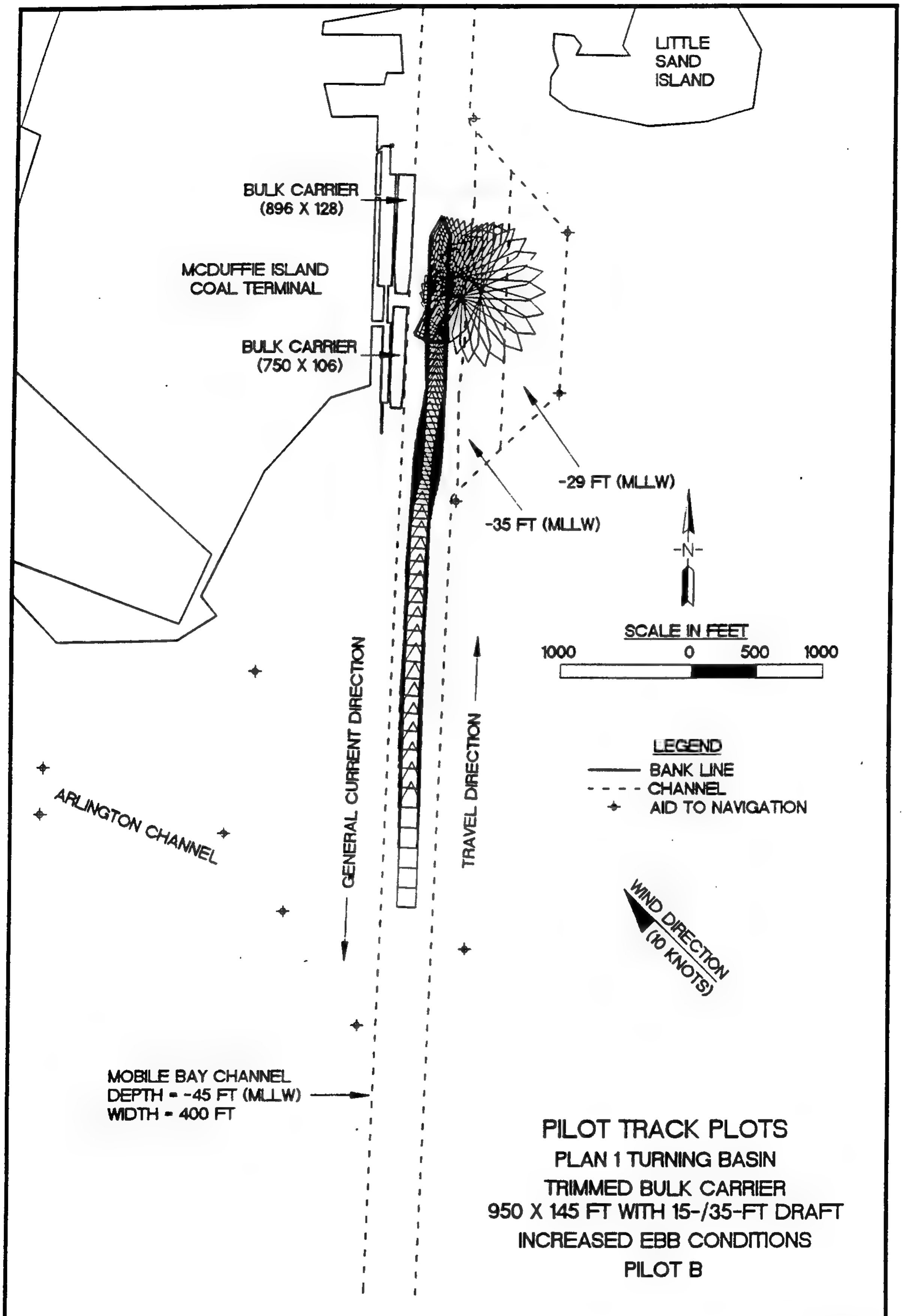
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-29 FT (MLLW)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
PILOT A



PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
PILOT A

Plate 18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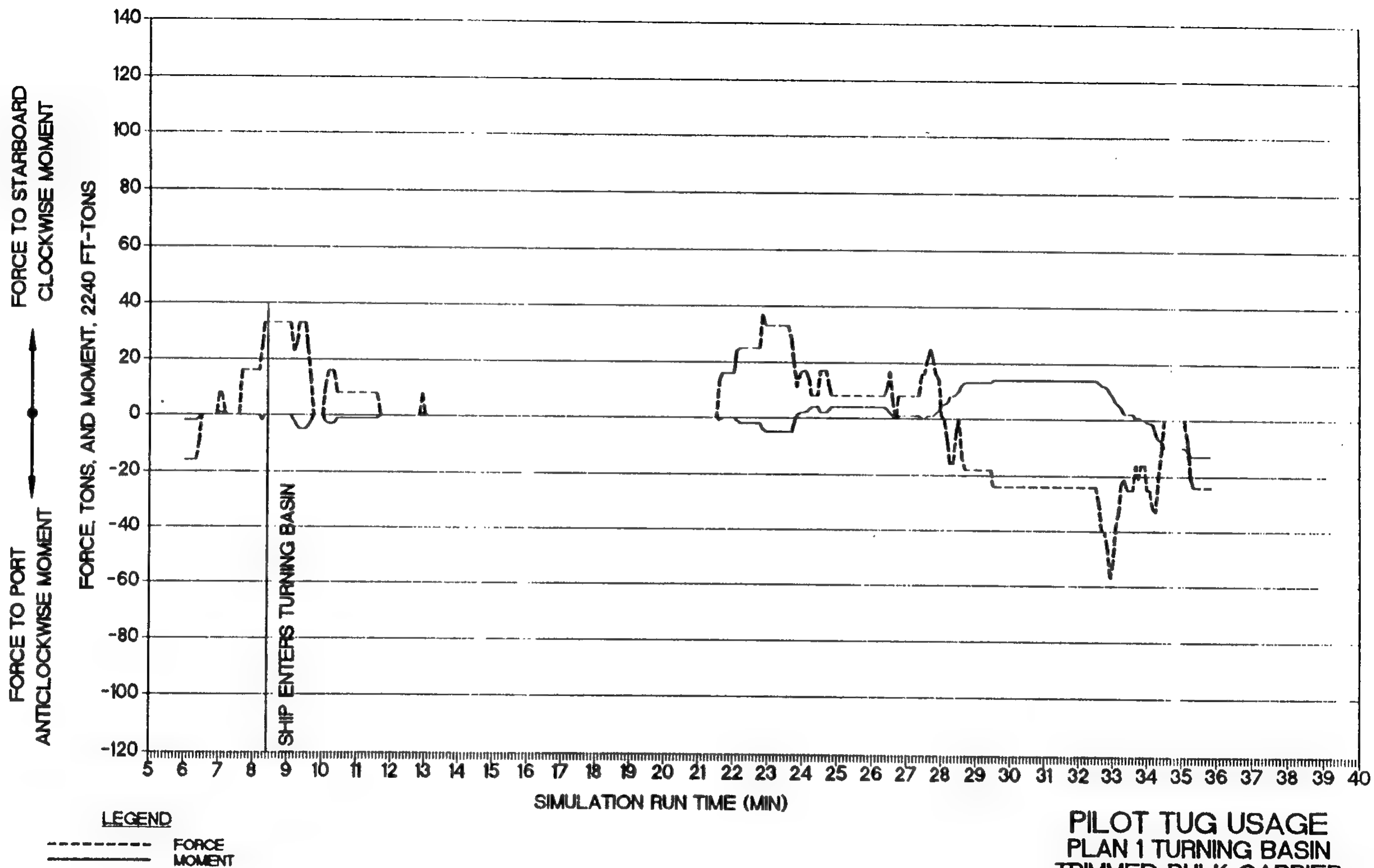
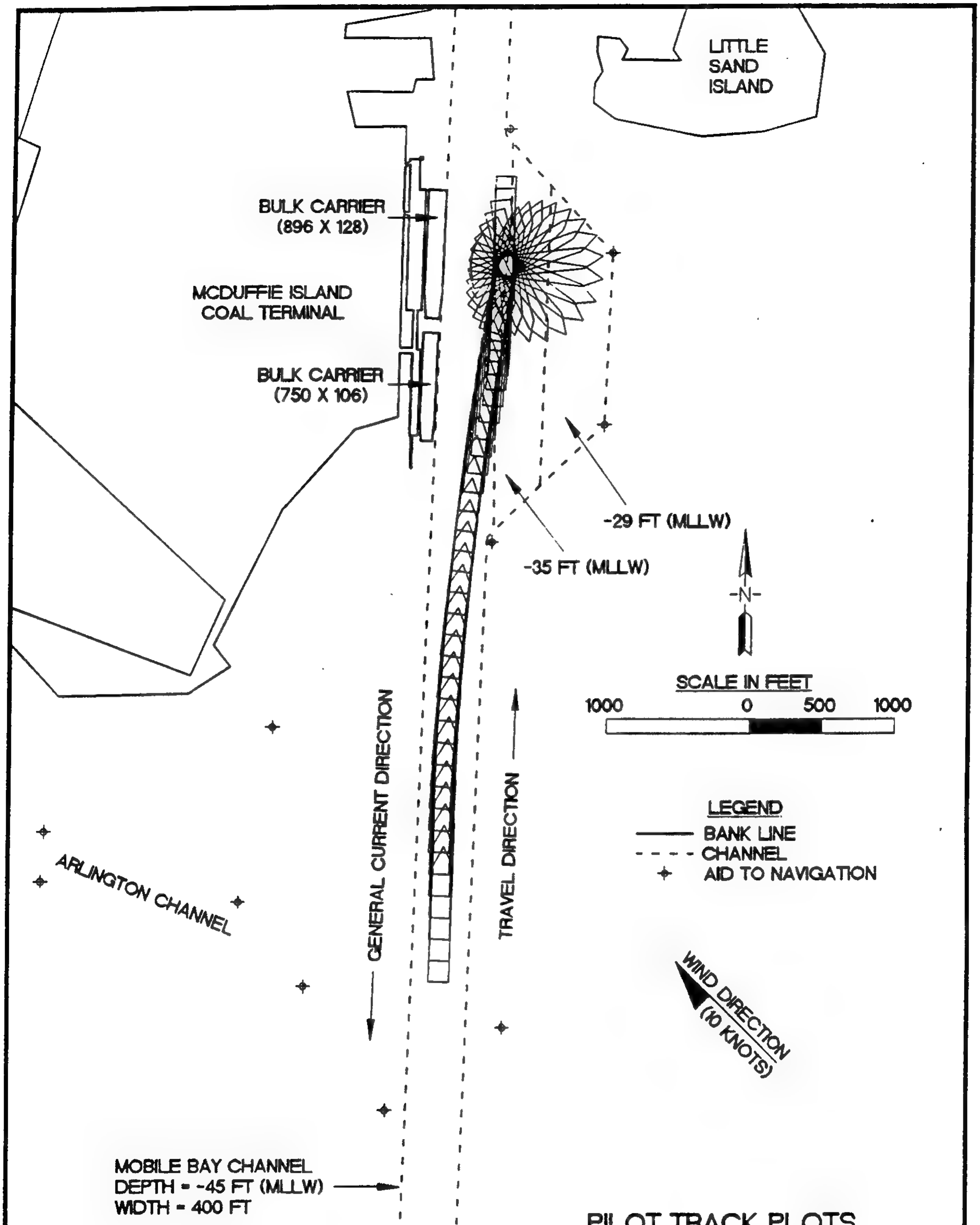
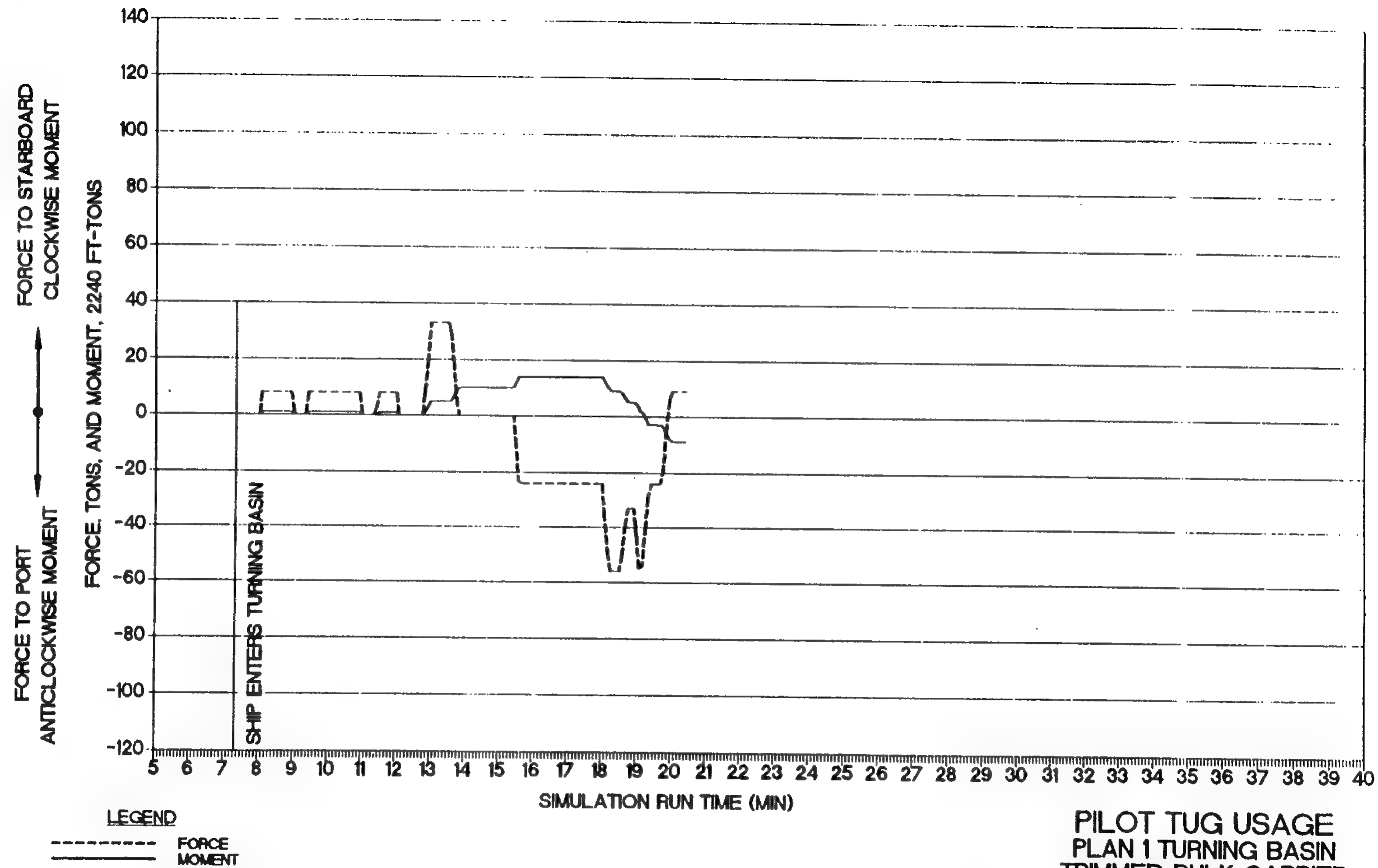
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-29 FT (MLLW)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
PILOT B



PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
PILOT B

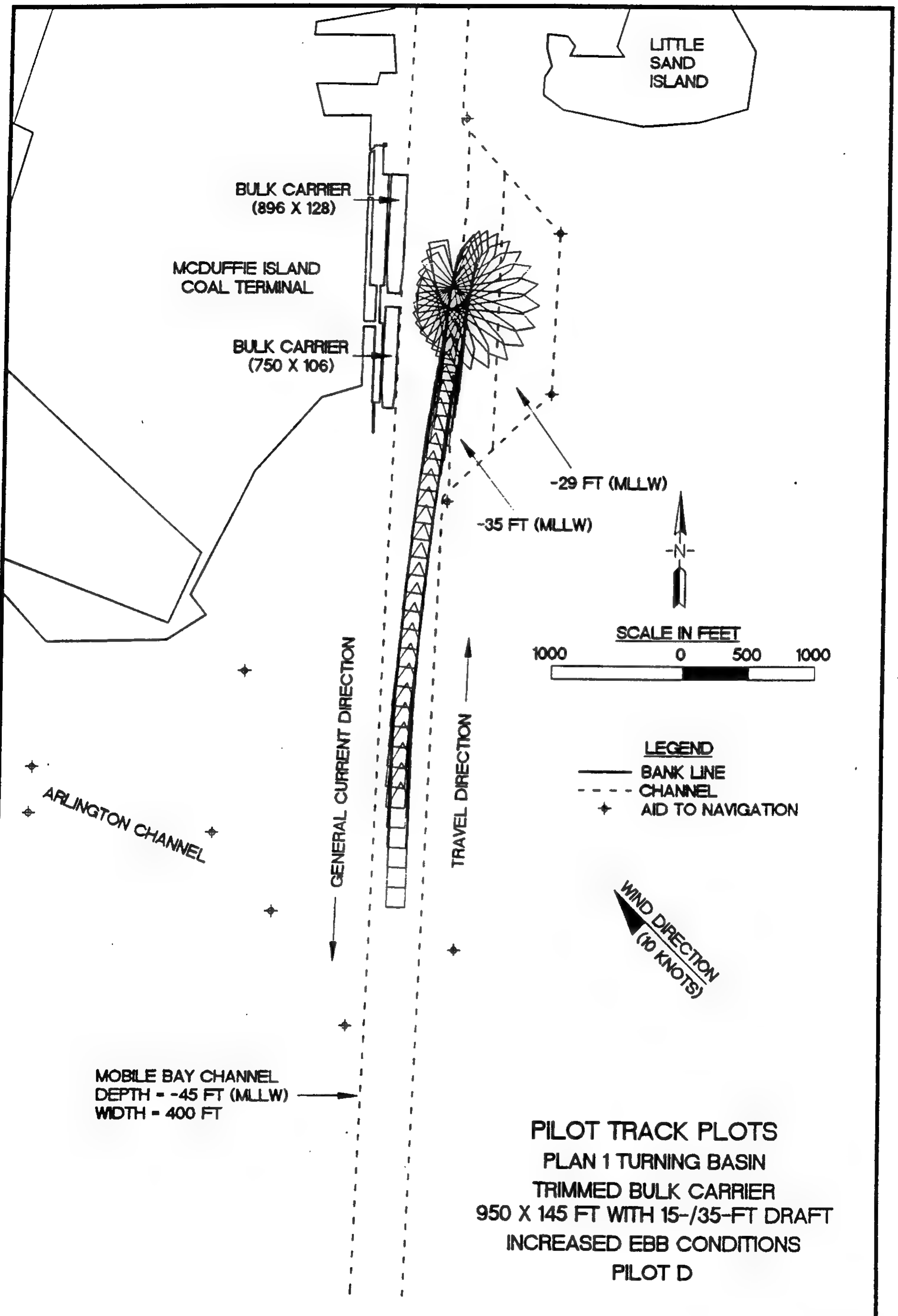


PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
PILOT C

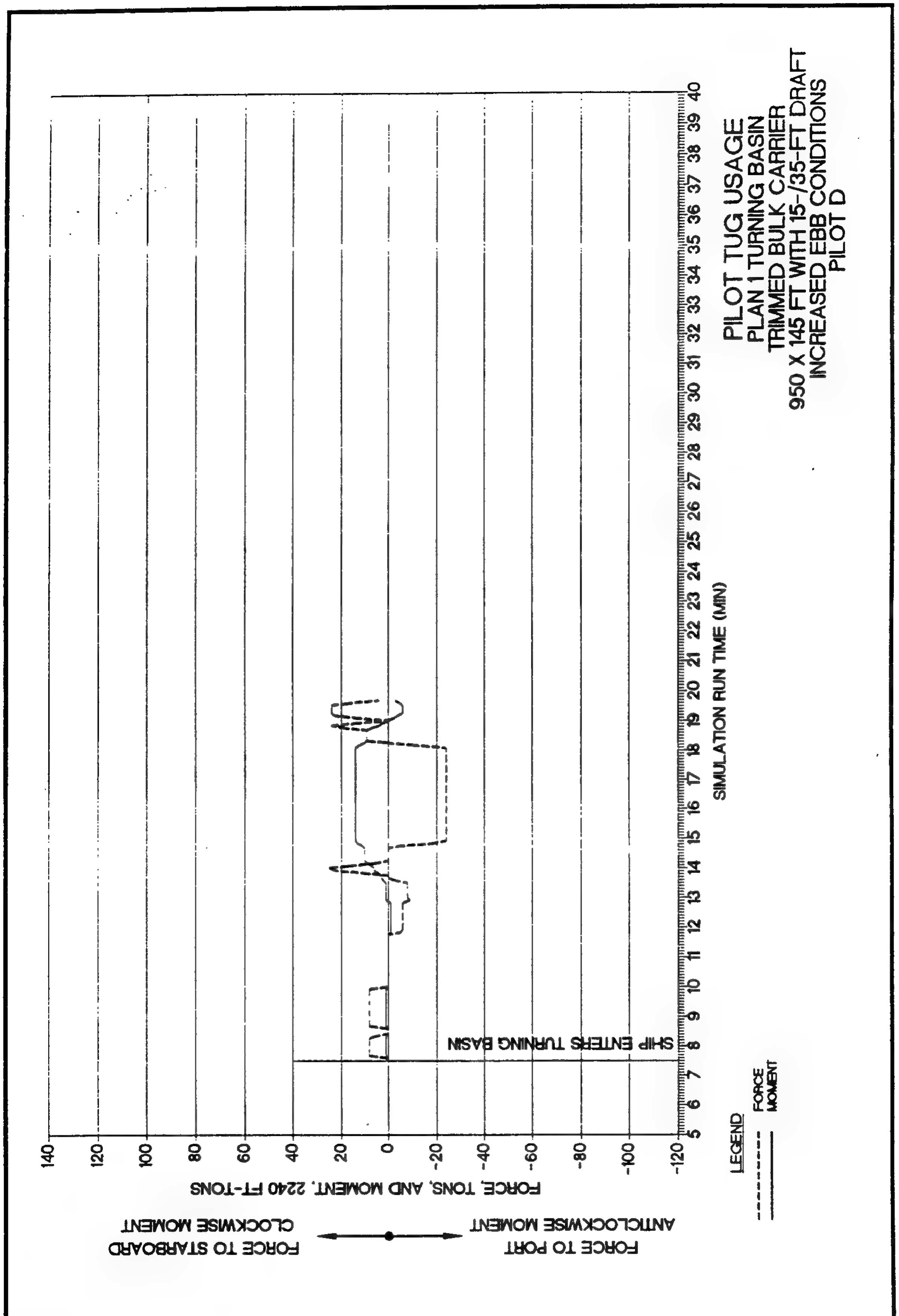


PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
PILOT C

Plate 22



PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
PILOT D


PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
PILOT D
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
FORCE
MOMENT

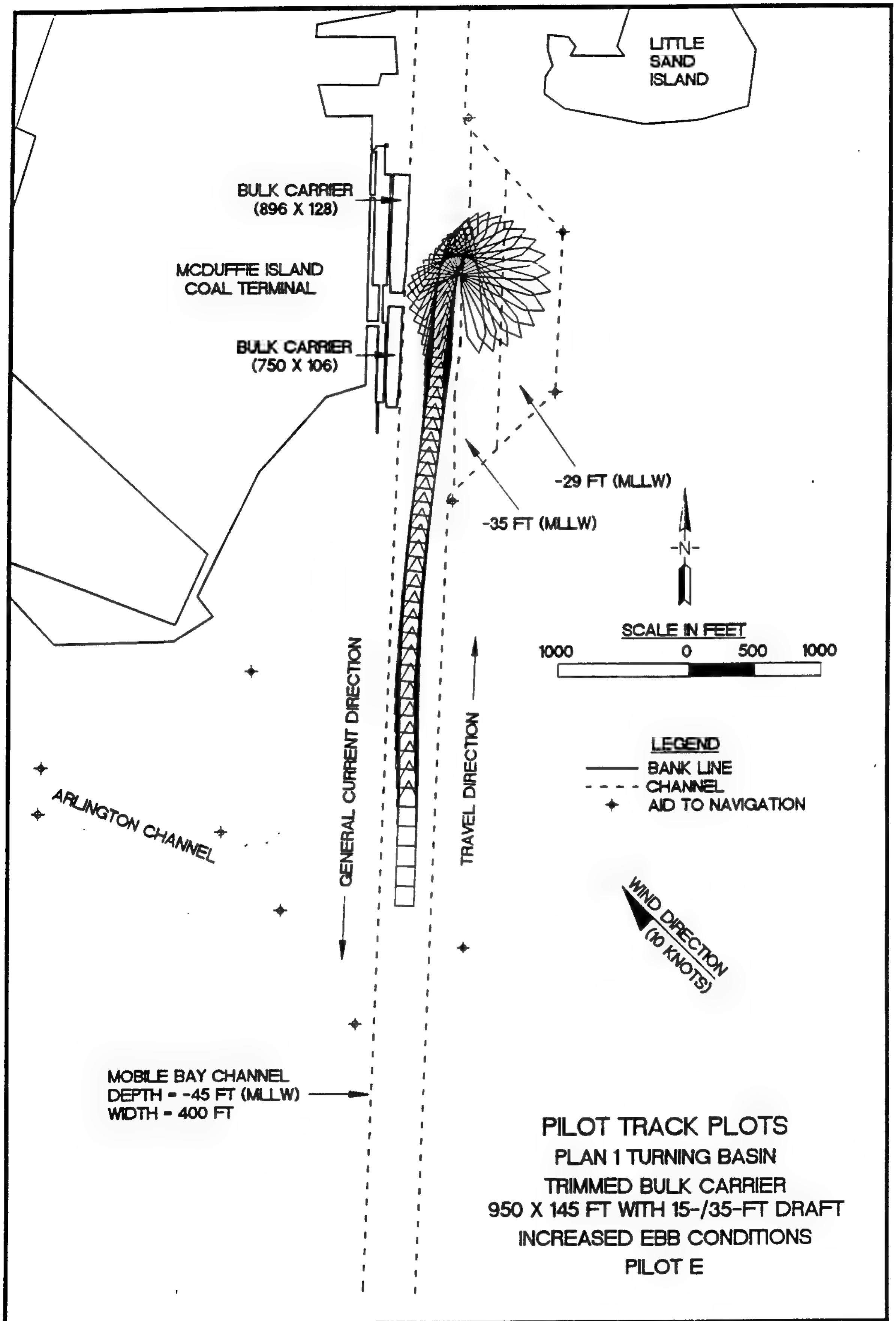
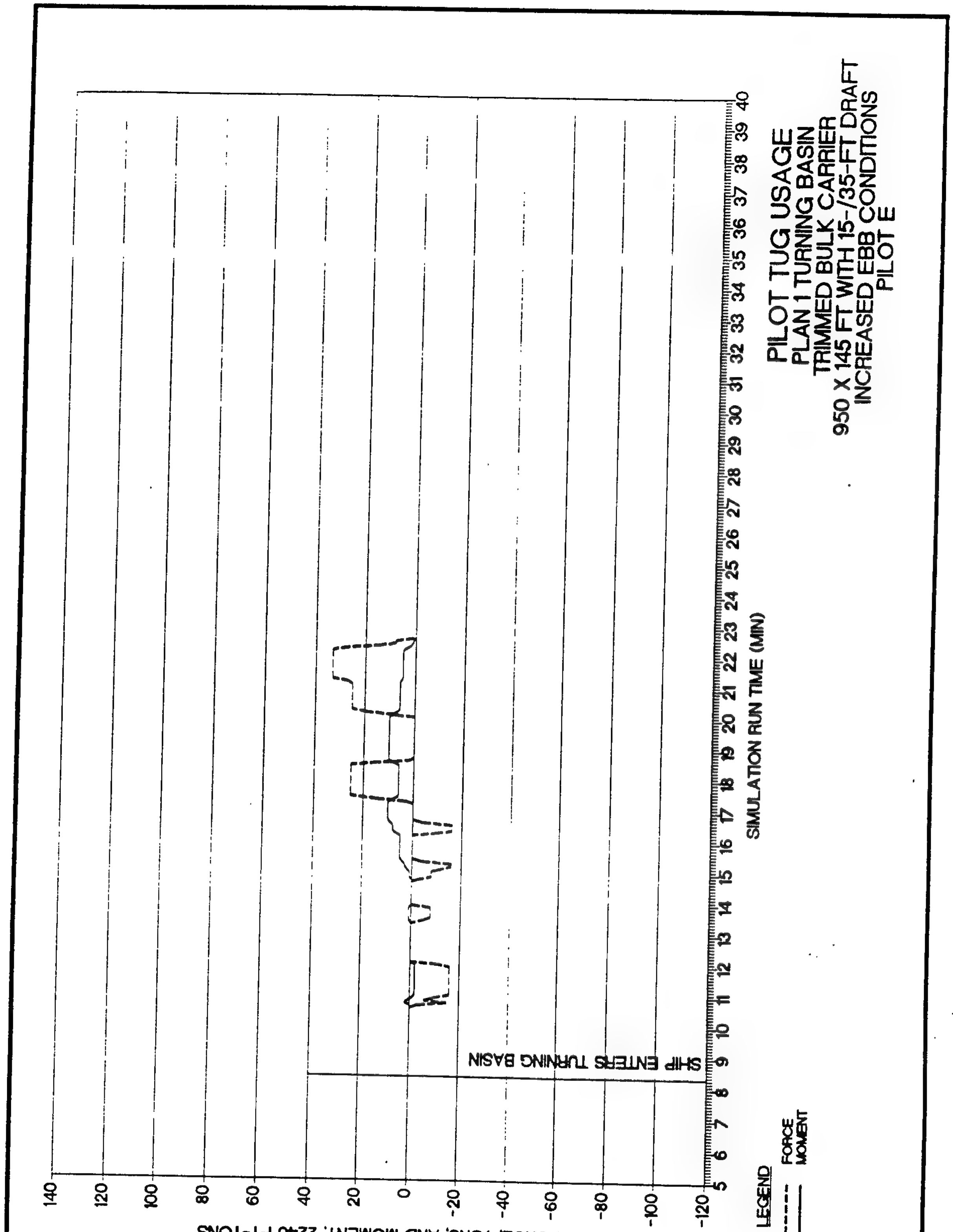
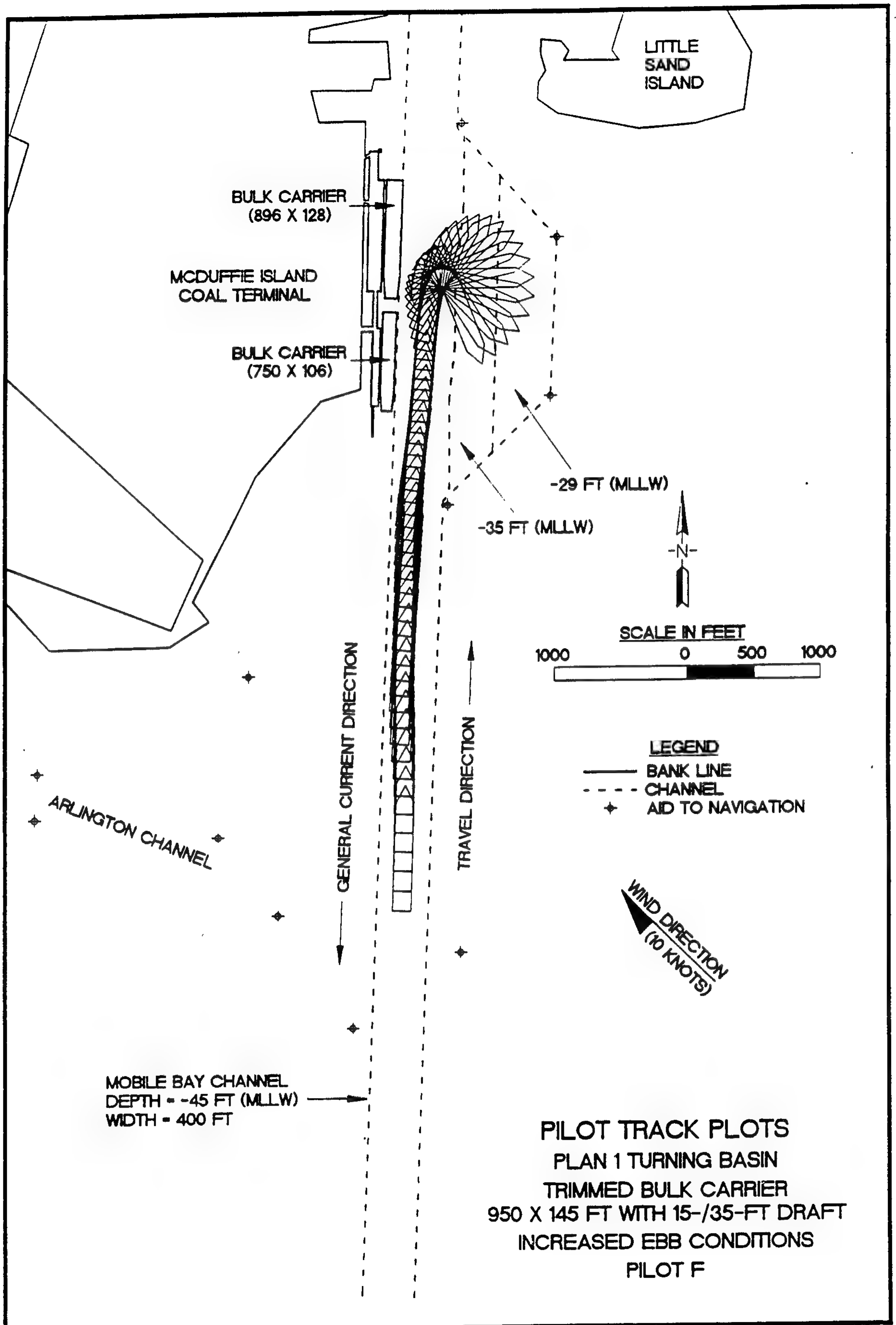

LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-29 FT (MLLW)
-35 FT (MLLW)
N
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
PILOT E

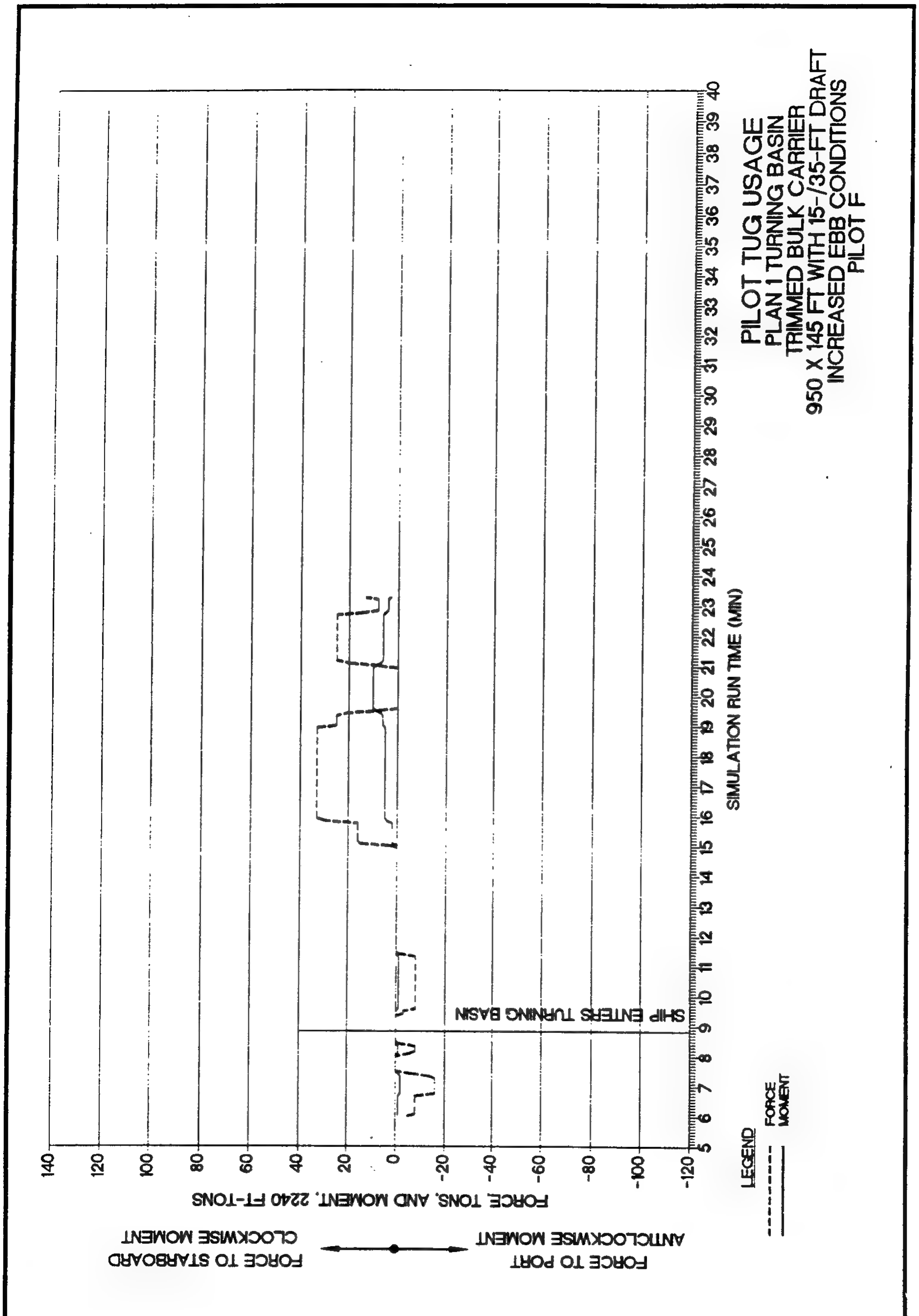
Plate 25


PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
PILOT E
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
FORCE
MOMENT
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40



LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-29 FT (MLLW)
-35 FT (MLLW)
N
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
PILOT F

Plate 27


PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
PILOT F
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
FORCE
MOMENT
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
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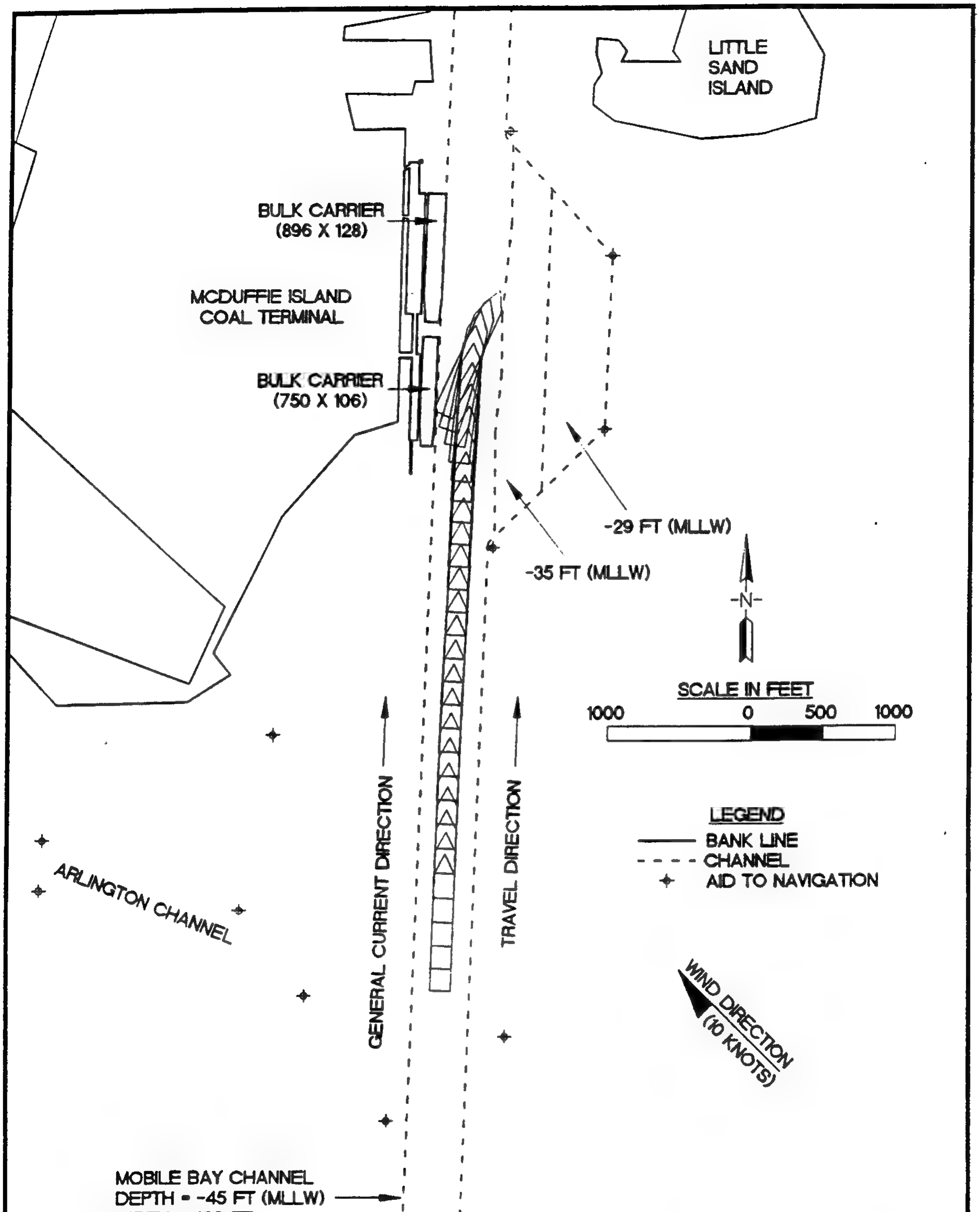
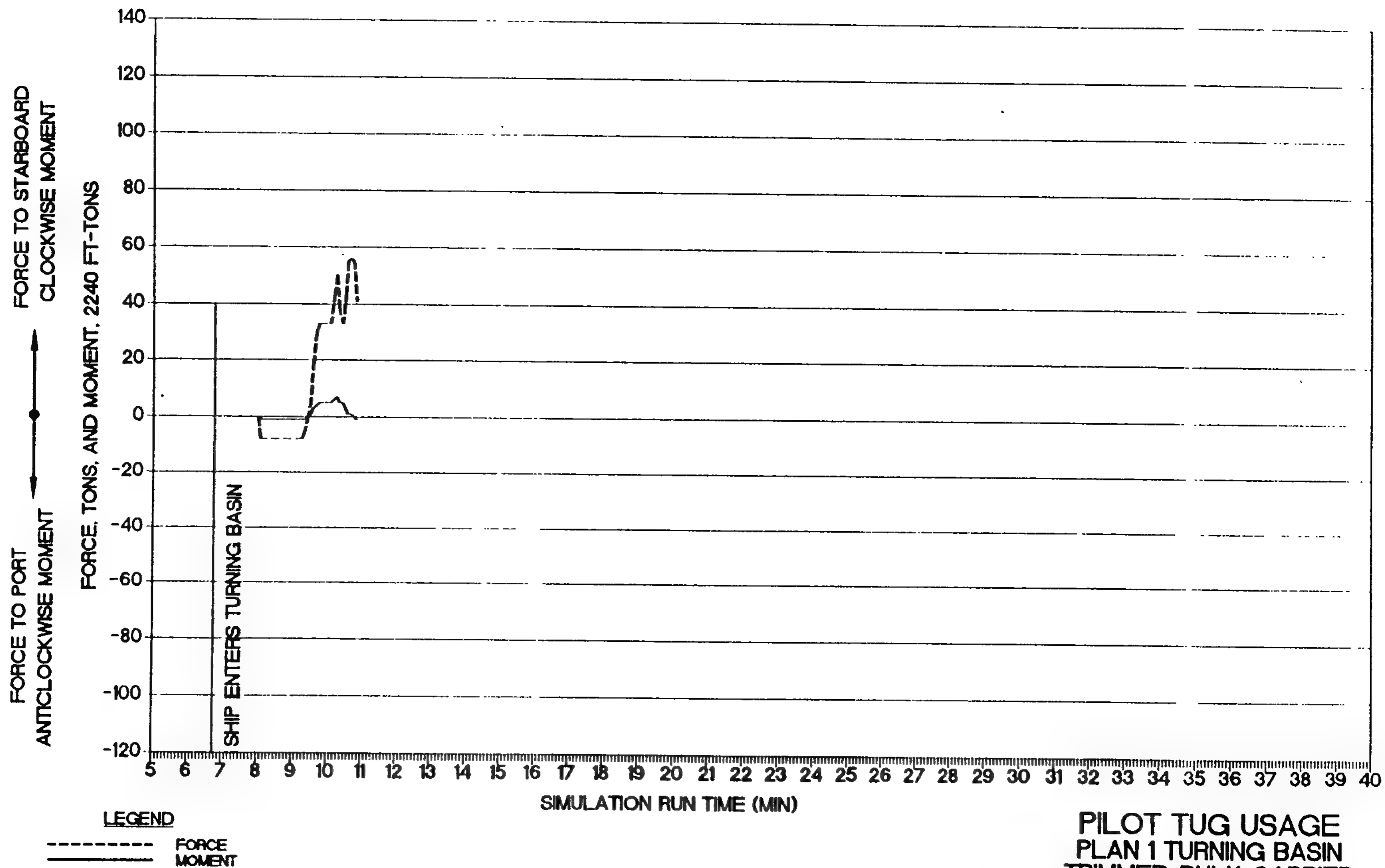
33
34
35
36
37
38
39
40

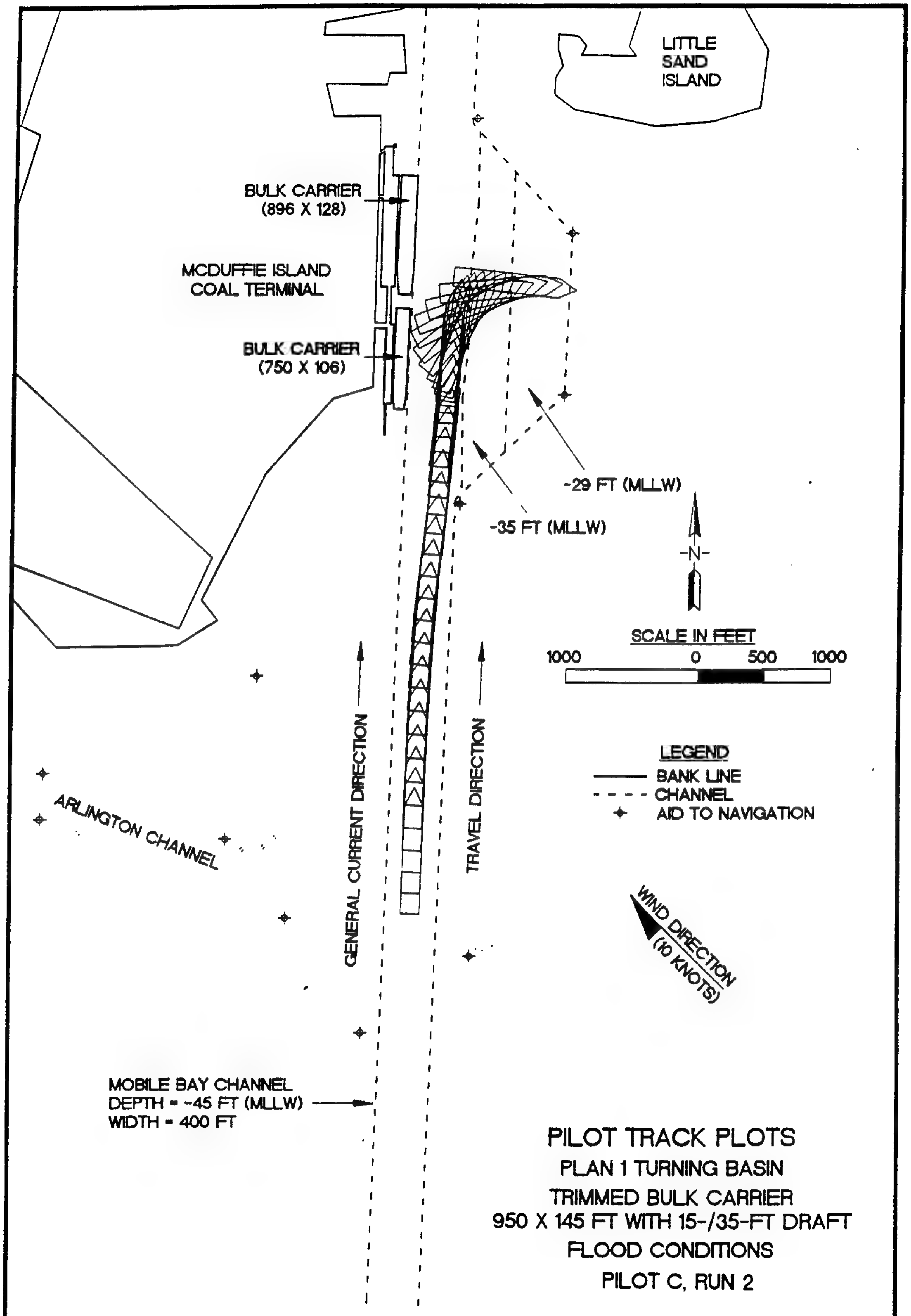
Plate 28

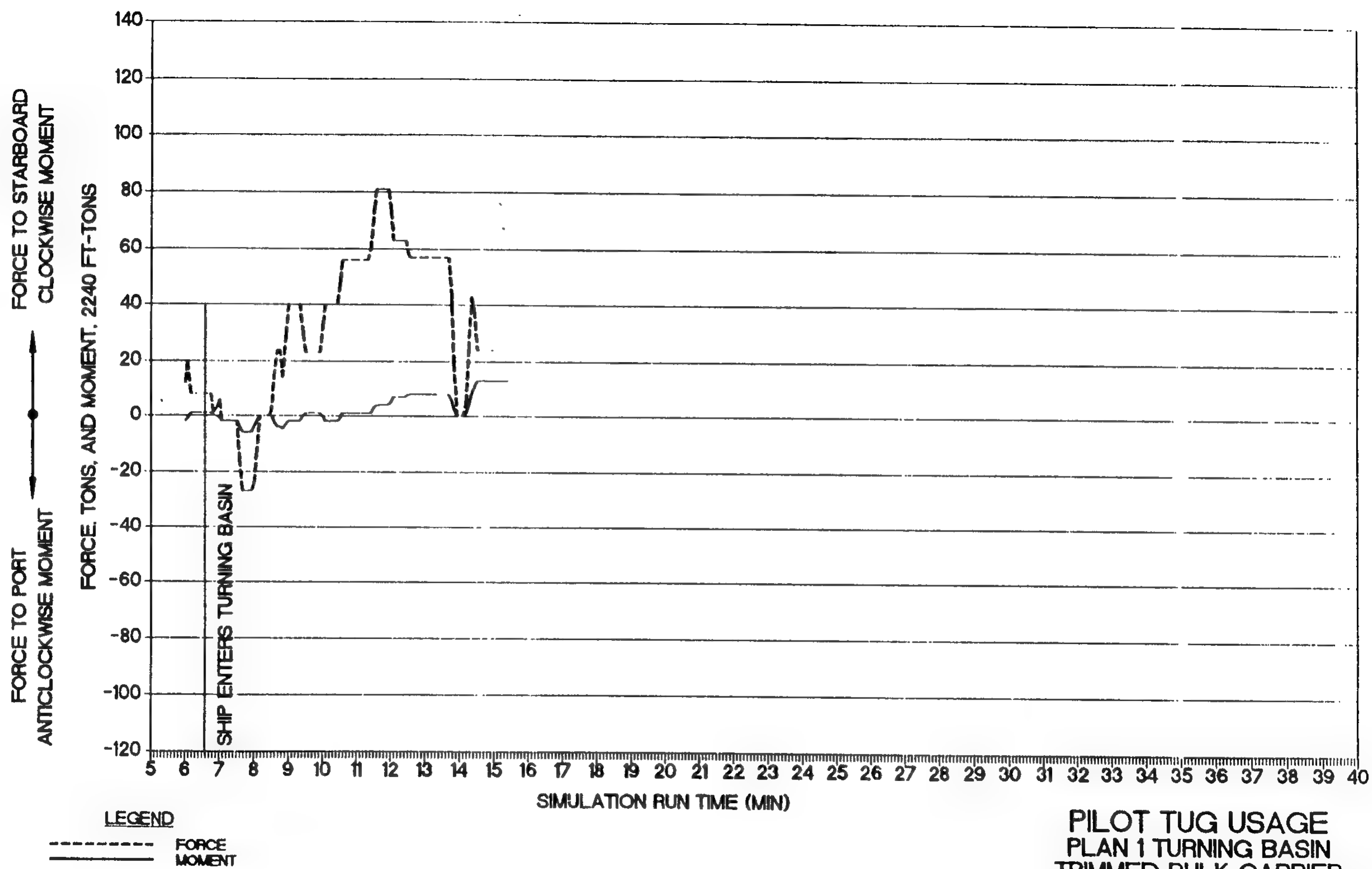


PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
FLOOD CONDITIONS
PILOT C, RUN 1

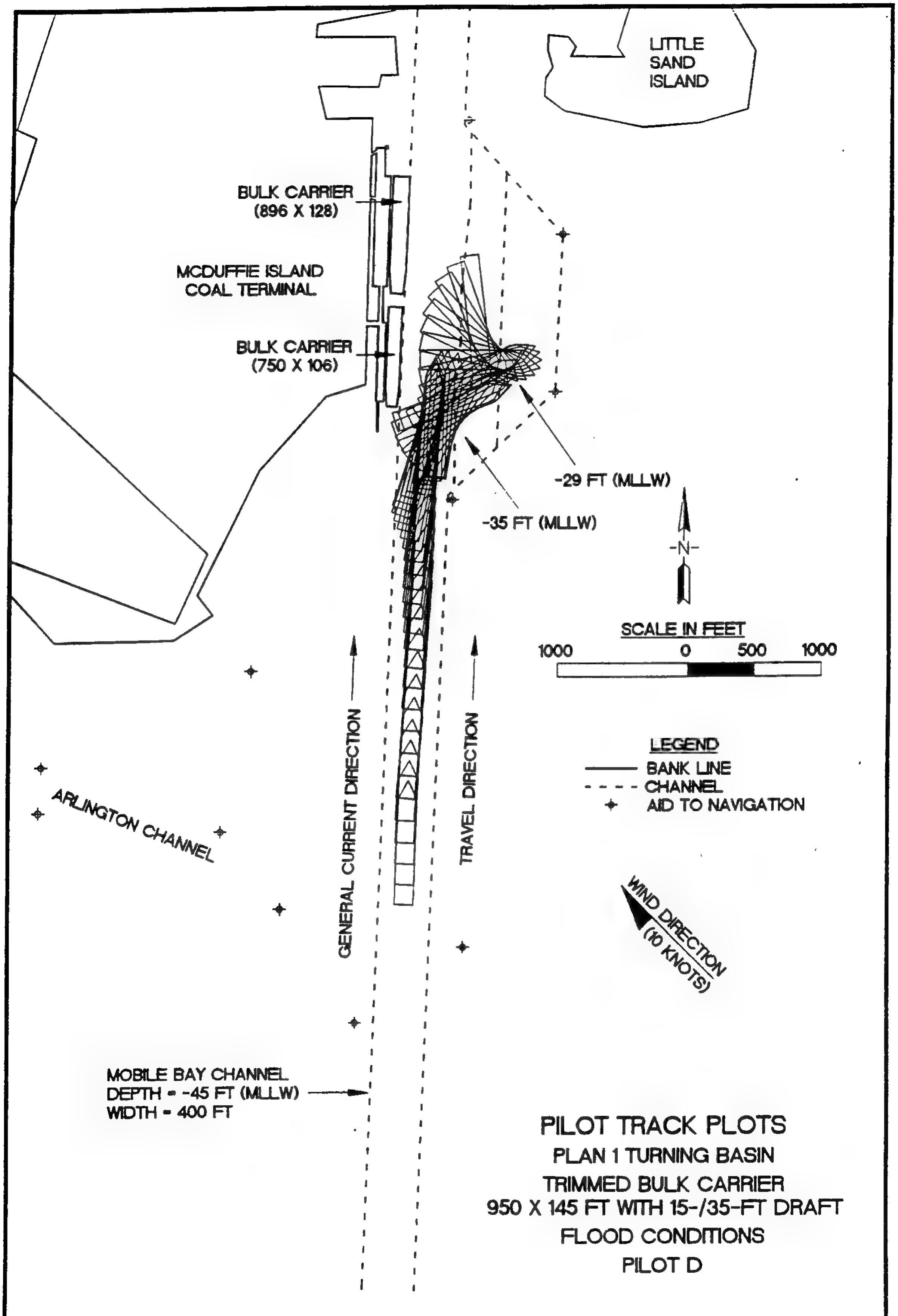


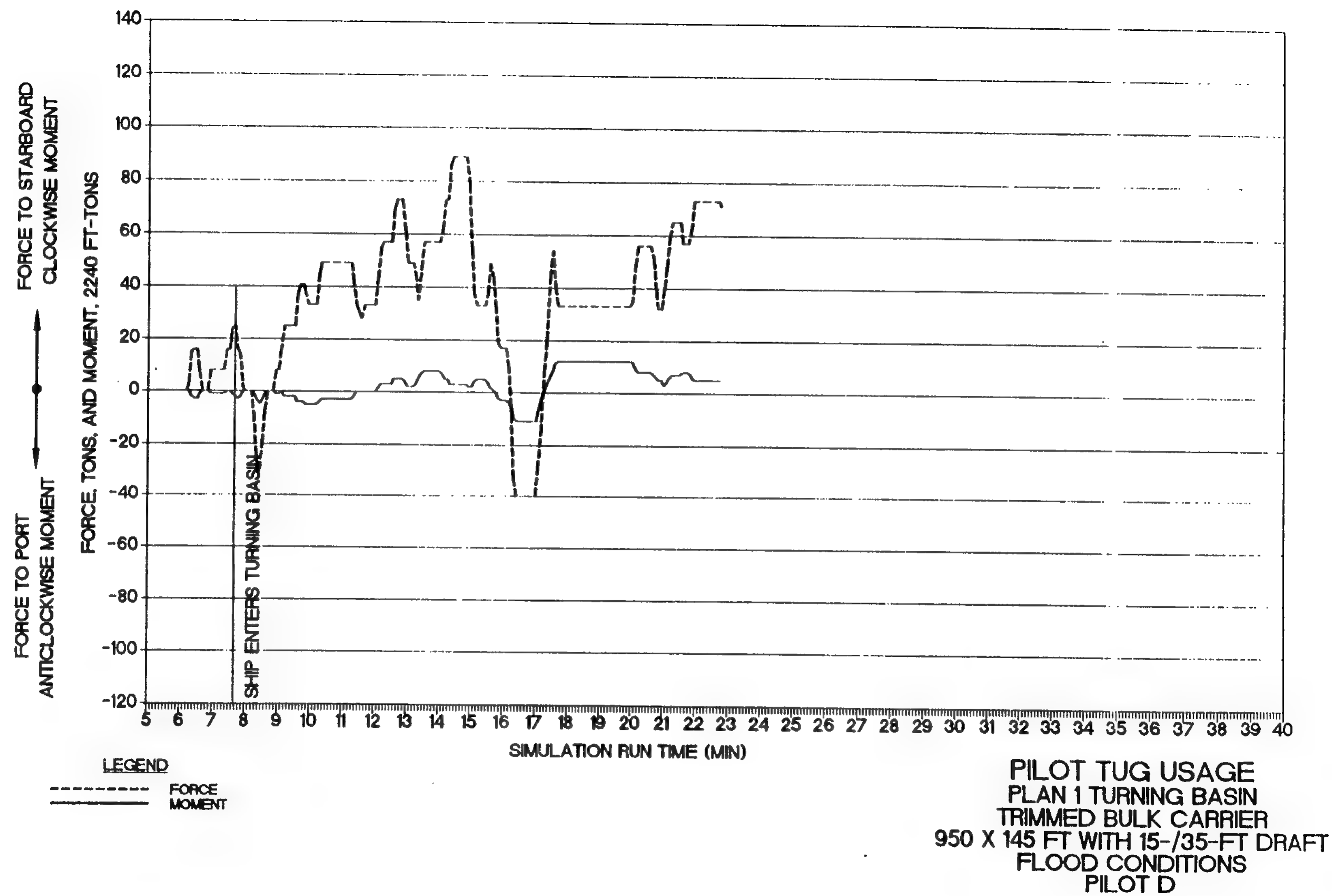
PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
FLOOD CONDITIONS
PILOT C, RUN 1

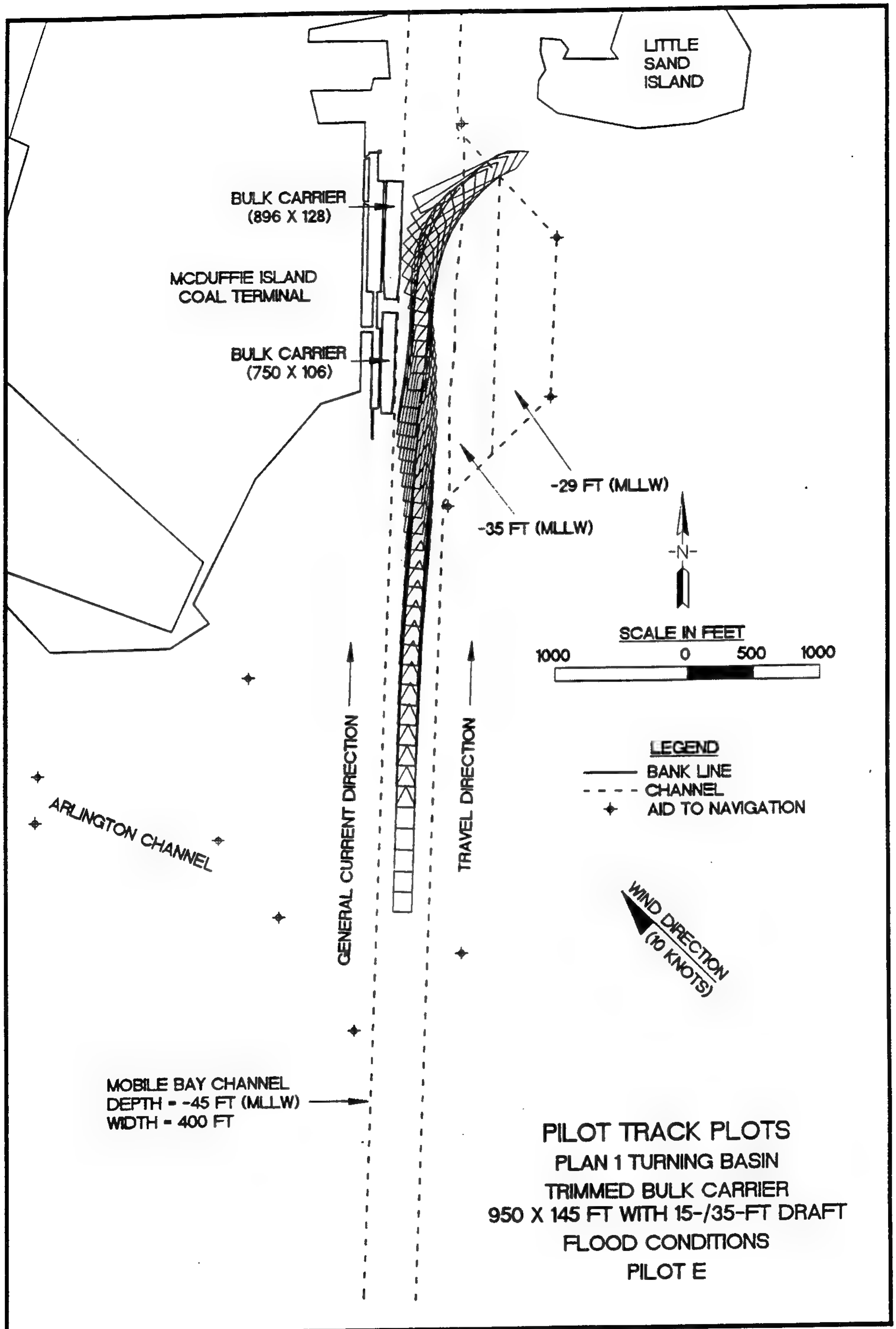

LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-29 FT (MLLW)
-35 FT (MLLW)
N
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
FLOOD CONDITIONS
PILOT C, RUN 2

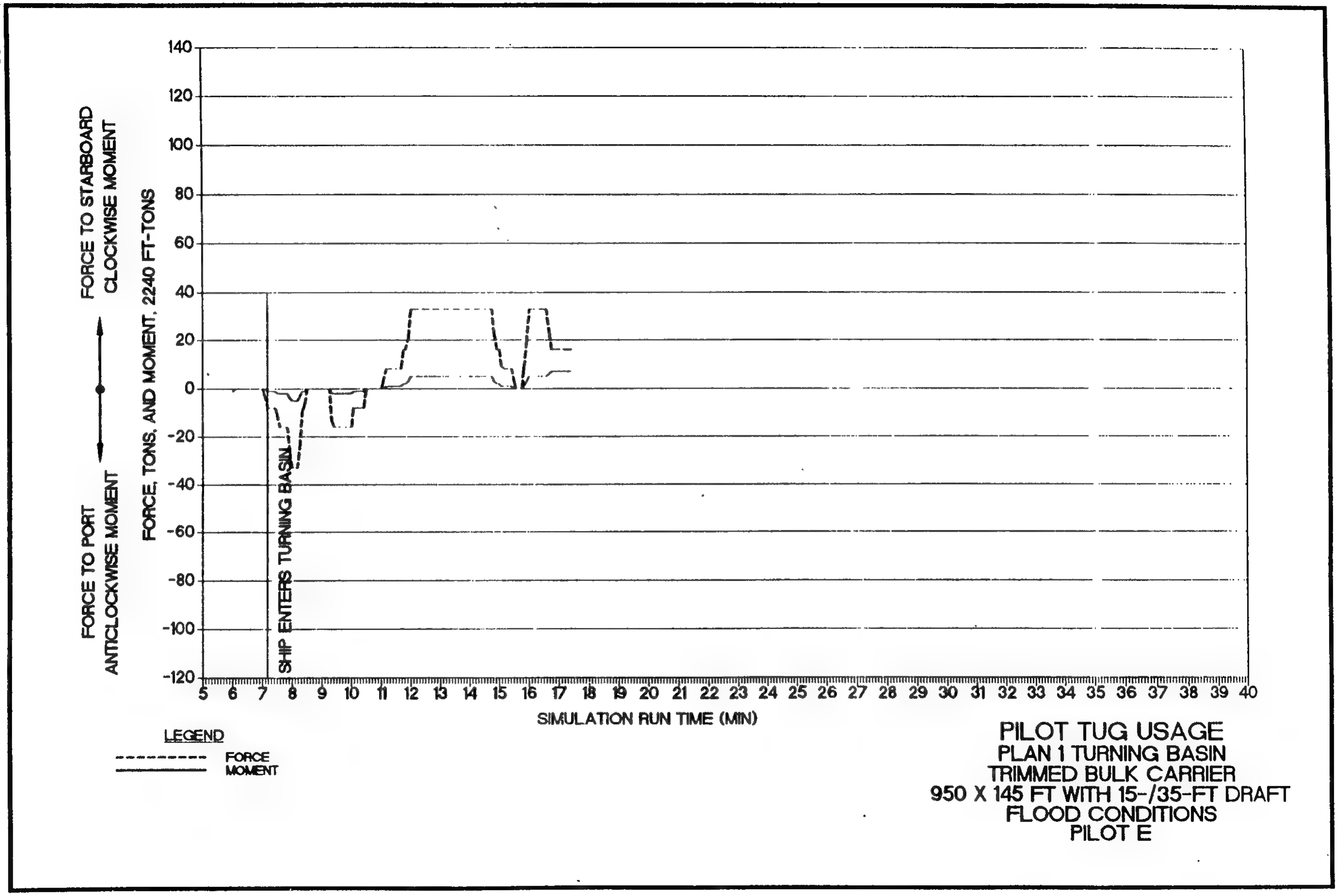


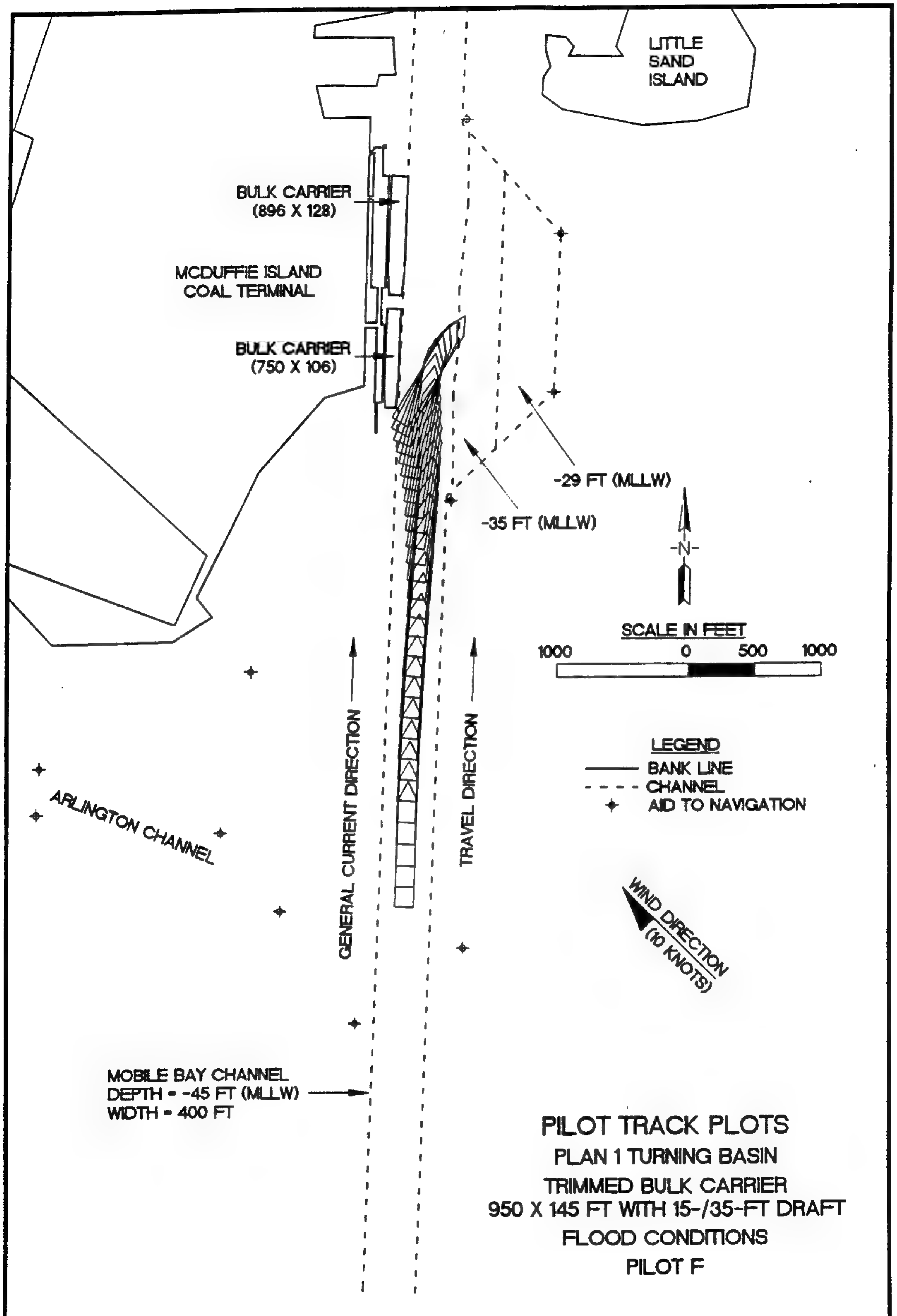
PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
FLOOD CONDITIONS
PILOT C, RUN 2


LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-29 FT (MLLW)
-35 FT (MLLW)
N
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
FLOOD CONDITIONS
PILOT D

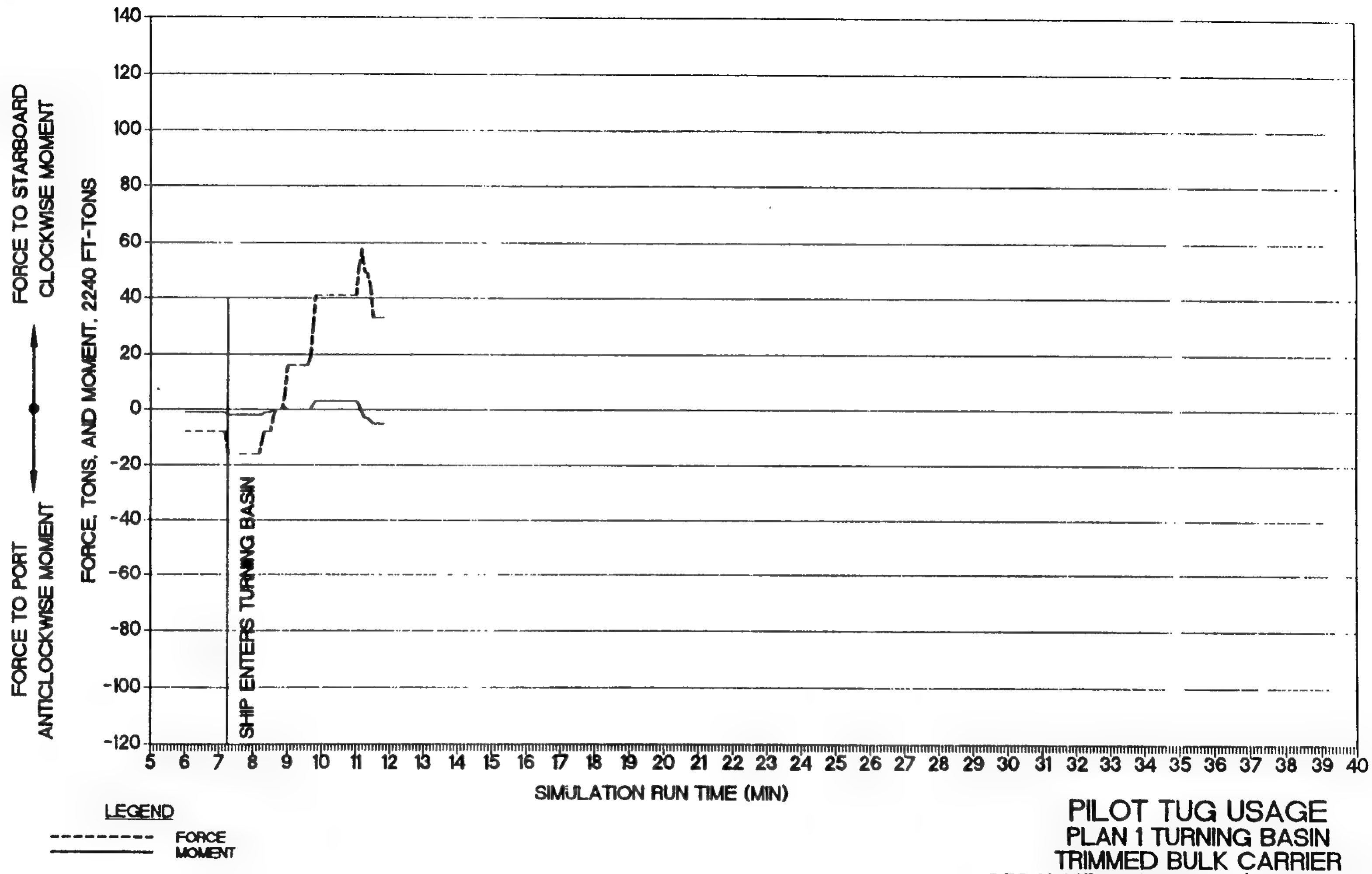

FORCE TO STARBOARD
CLOCKWISE MOMENT
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE, TONS, AND MOMENT, 2240 FT-TONS
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
SHIP ENTERS TURNING BASIN
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
SIMULATION RUN TIME (MIN)
LEGEND
FORCE
MOMENT
PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
FLOOD CONDITIONS
PILOT D


LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-29 FT (MLLW)
-35 FT (MLLW)
N
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
FLOOD CONDITIONS
PILOT E

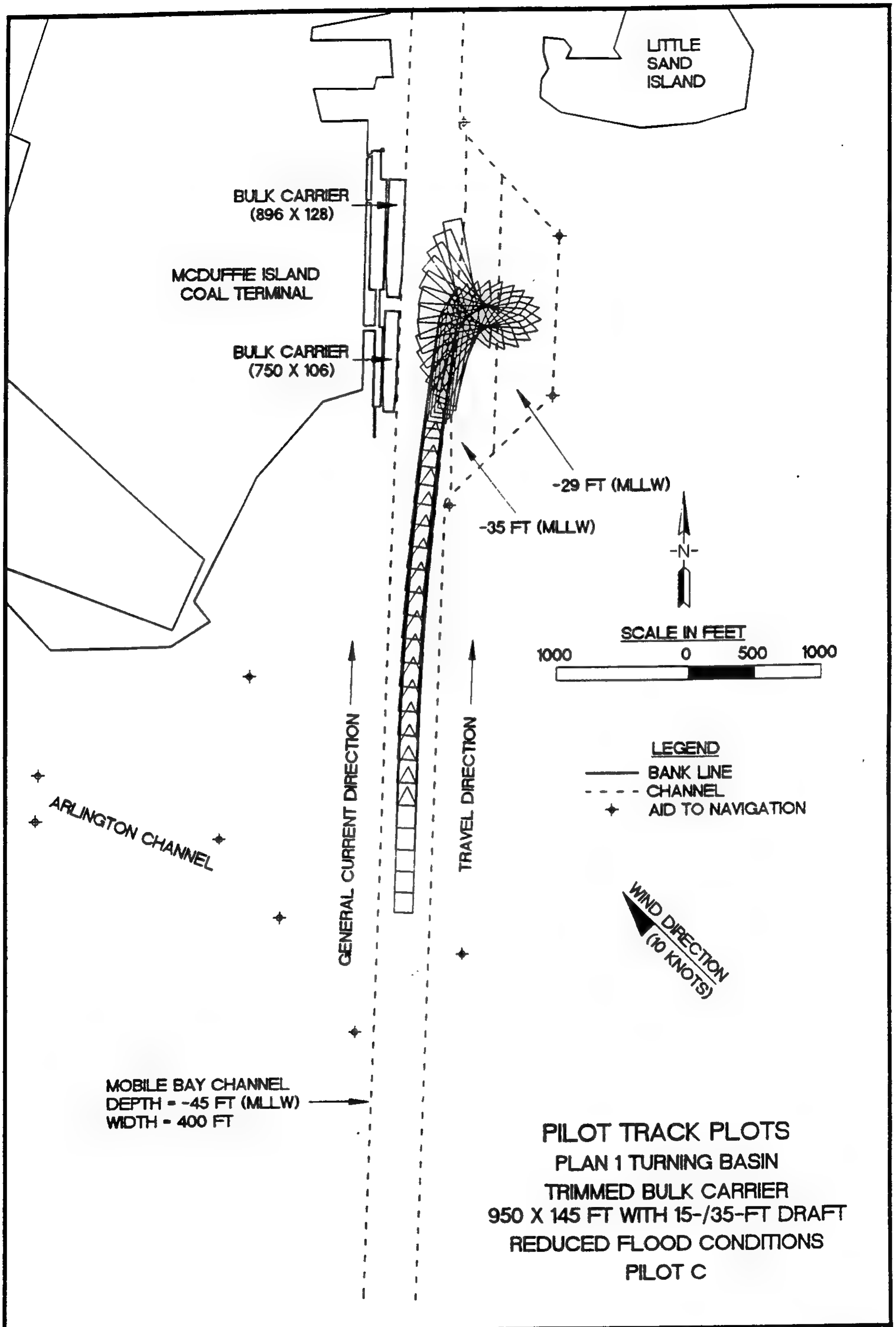

FORCE TO STARBOARD
CLOCKWISE MOMENT
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE, TONS, AND MOMENT, 2240 FT-TONS
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
SHIP ENTERS TURNING BASIN
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
SIMULATION RUN TIME (MIN)
LEGEND
FORCE
MOMENT
PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
FLOOD CONDITIONS
PILOT E



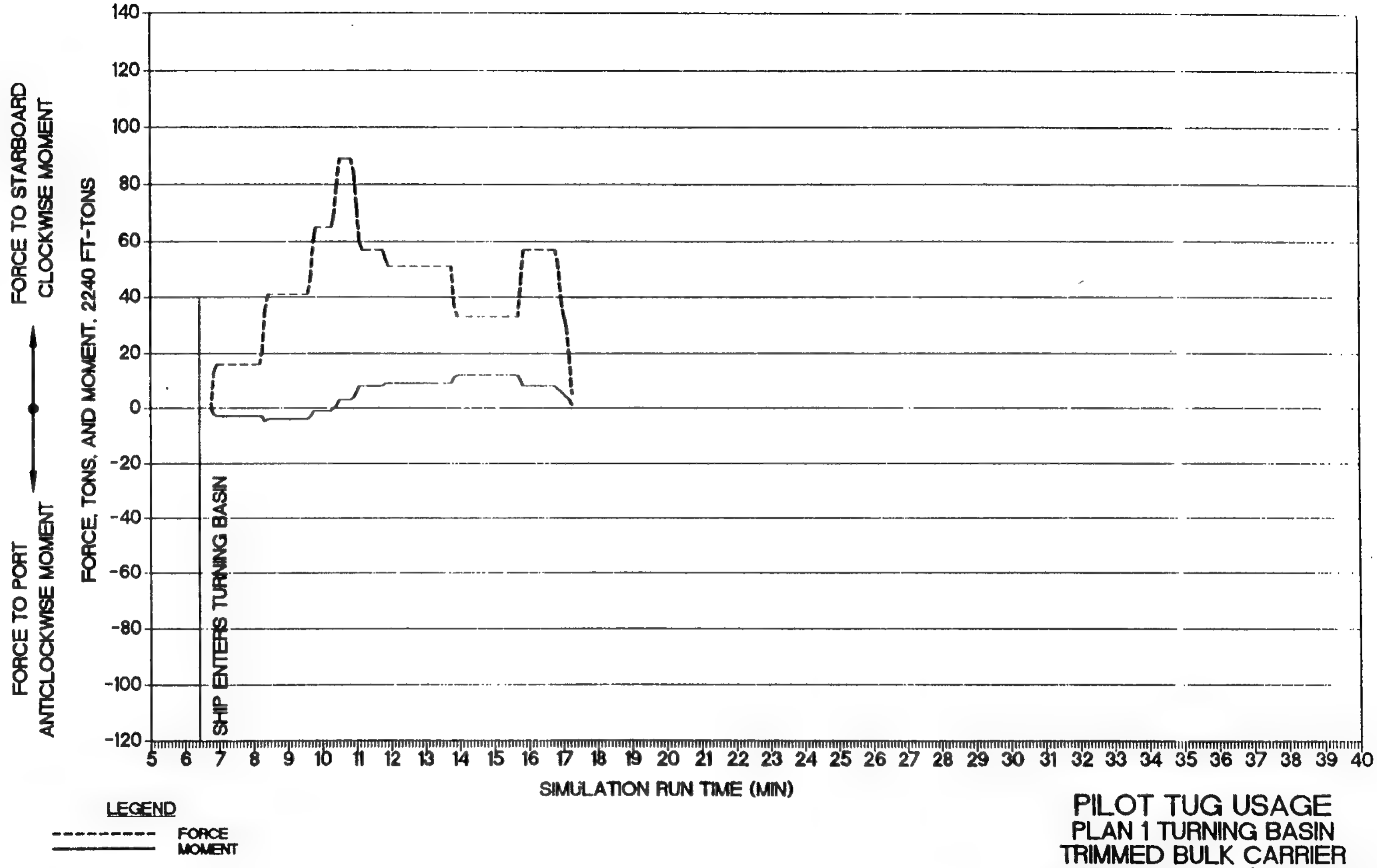
LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-29 FT (MLLW)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
FLOOD CONDITIONS
PILOT F



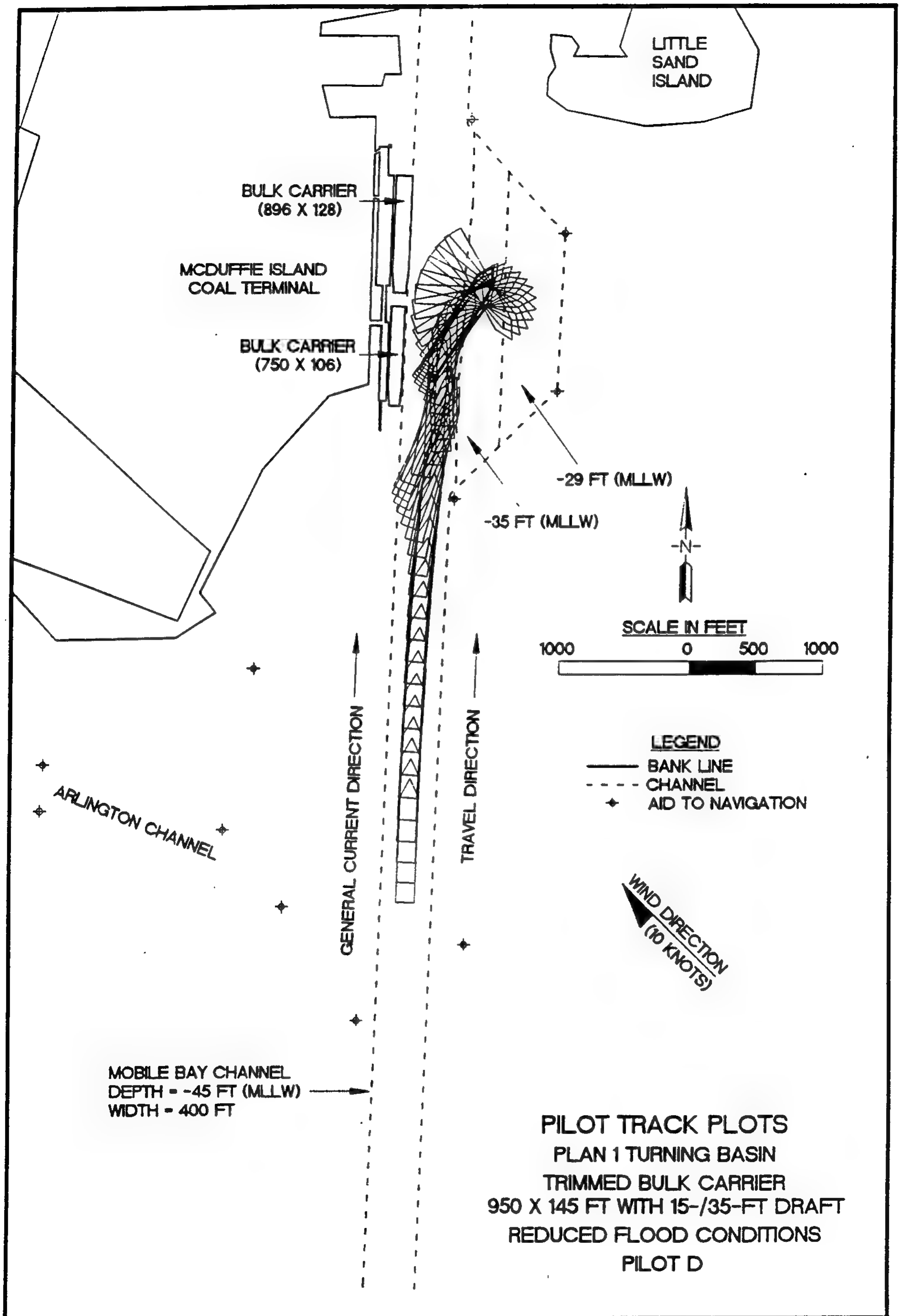
PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
FLOOD CONDITIONS
PILOT F



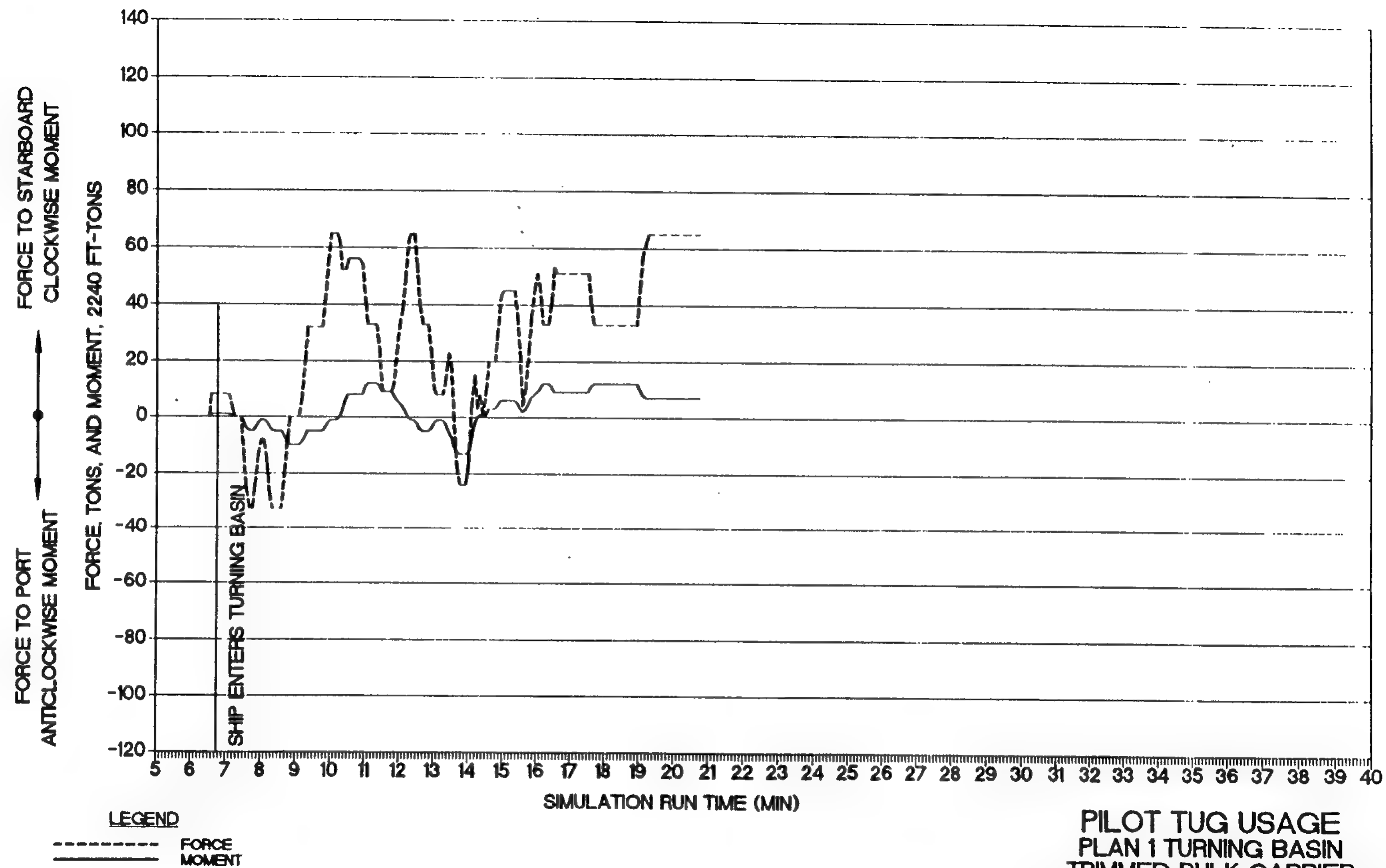
PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT C



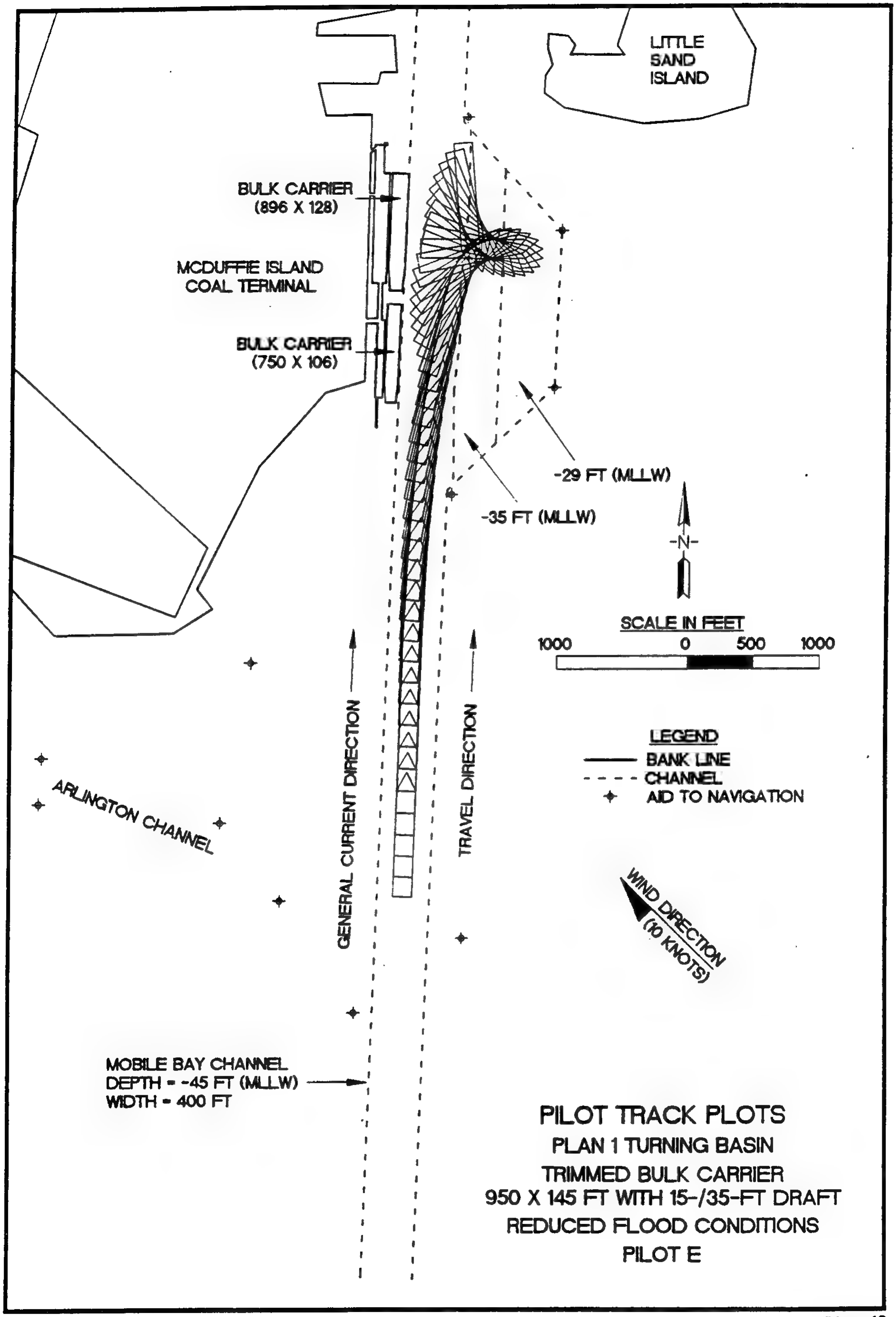
PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT C



PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT D



PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT D



LITTLE SAND ISLAND
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-29 FT (MLLW)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT E

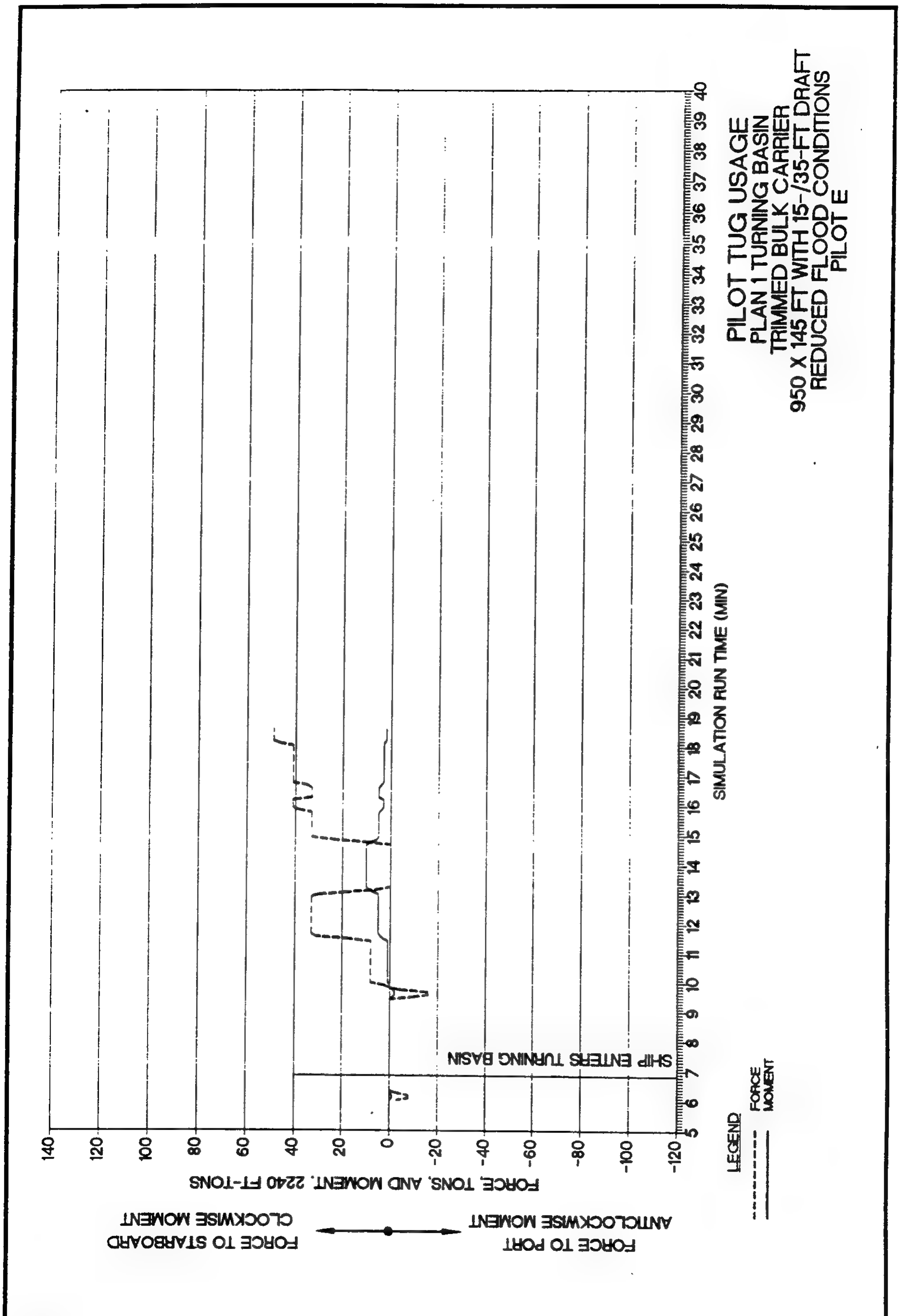
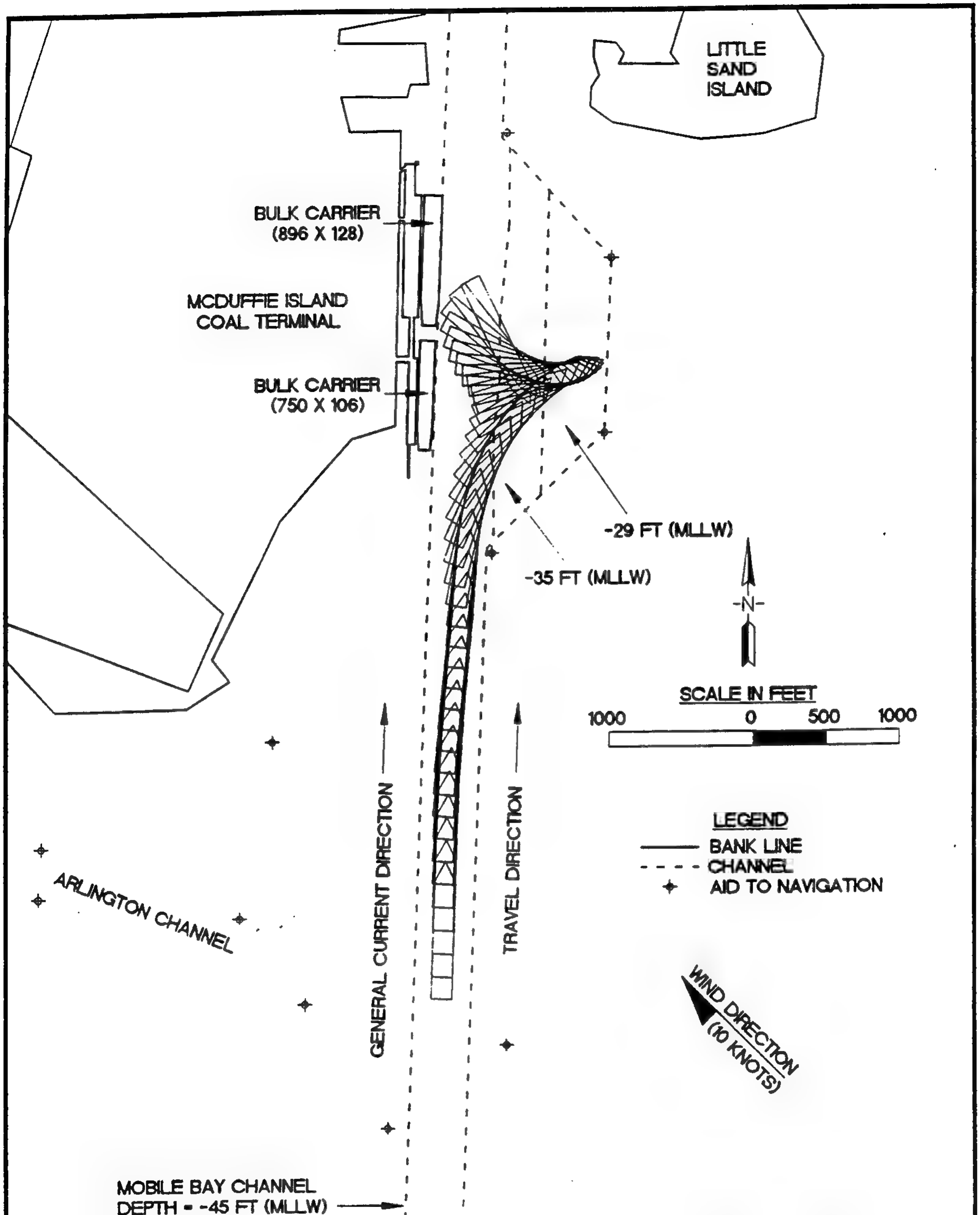
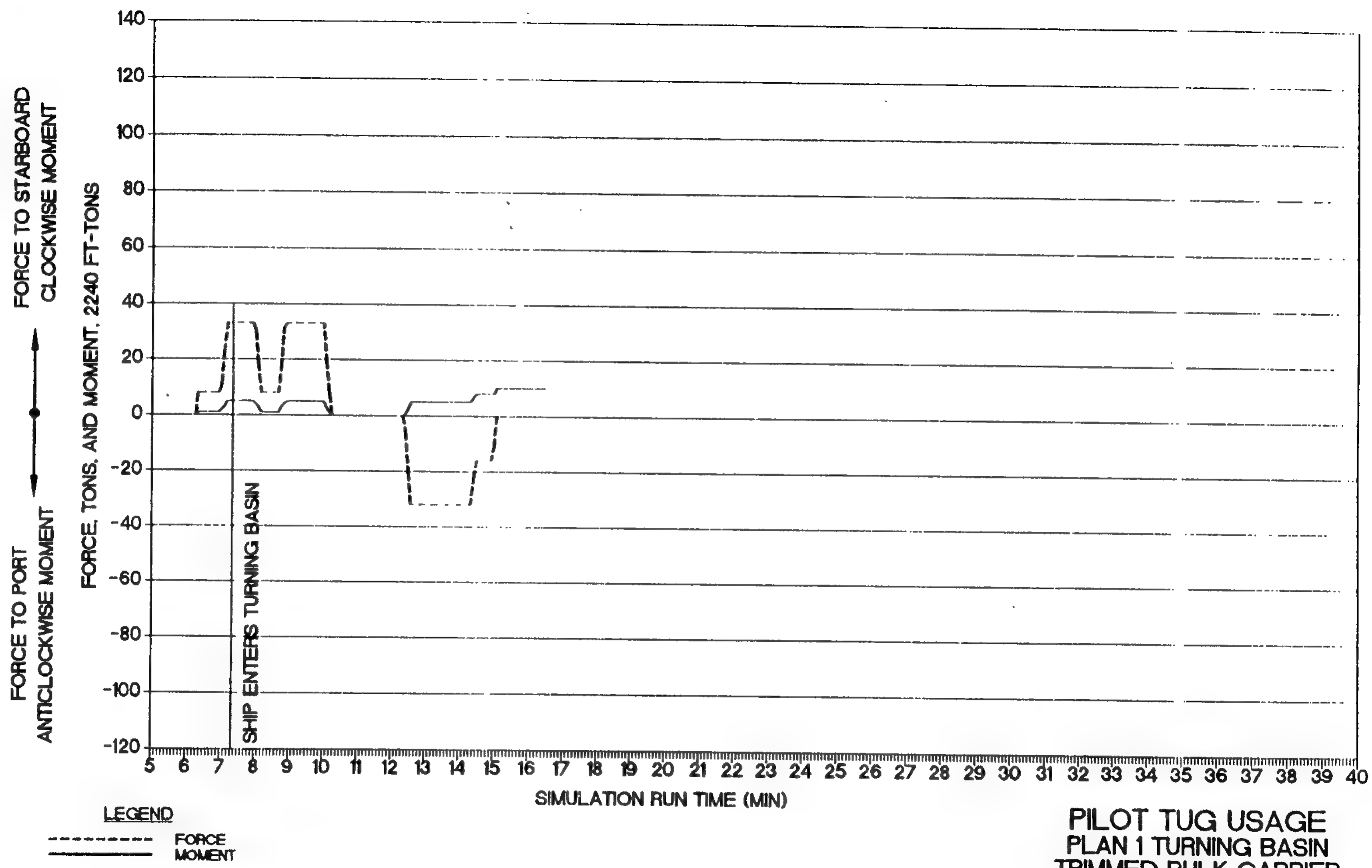

PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT E
SIMULATION RUN TIME (MIN)
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
FORCE, TONS, AND MOMENT, 2240 FT-TONS
140 120 100 80 60 40 20 0 -20 -40 -60 -80 -100 -120
SHIP ENTERS TURNING BASIN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
LEGEND
FORCE
MOMENT

Plate 44

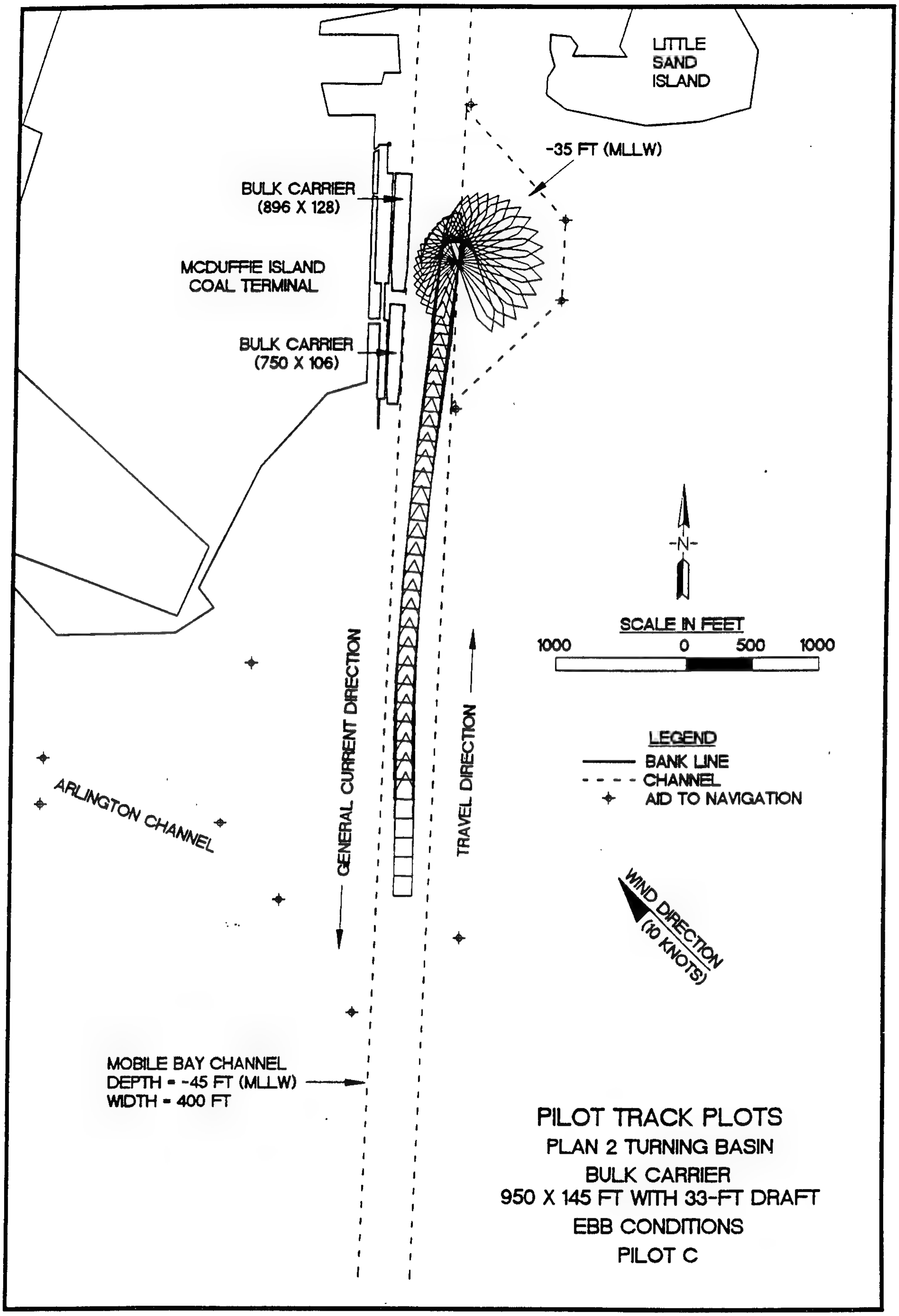


PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT F



PILOT TUG USAGE
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT F

Plan 2 Results



PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
EBB CONDITIONS
PILOT C

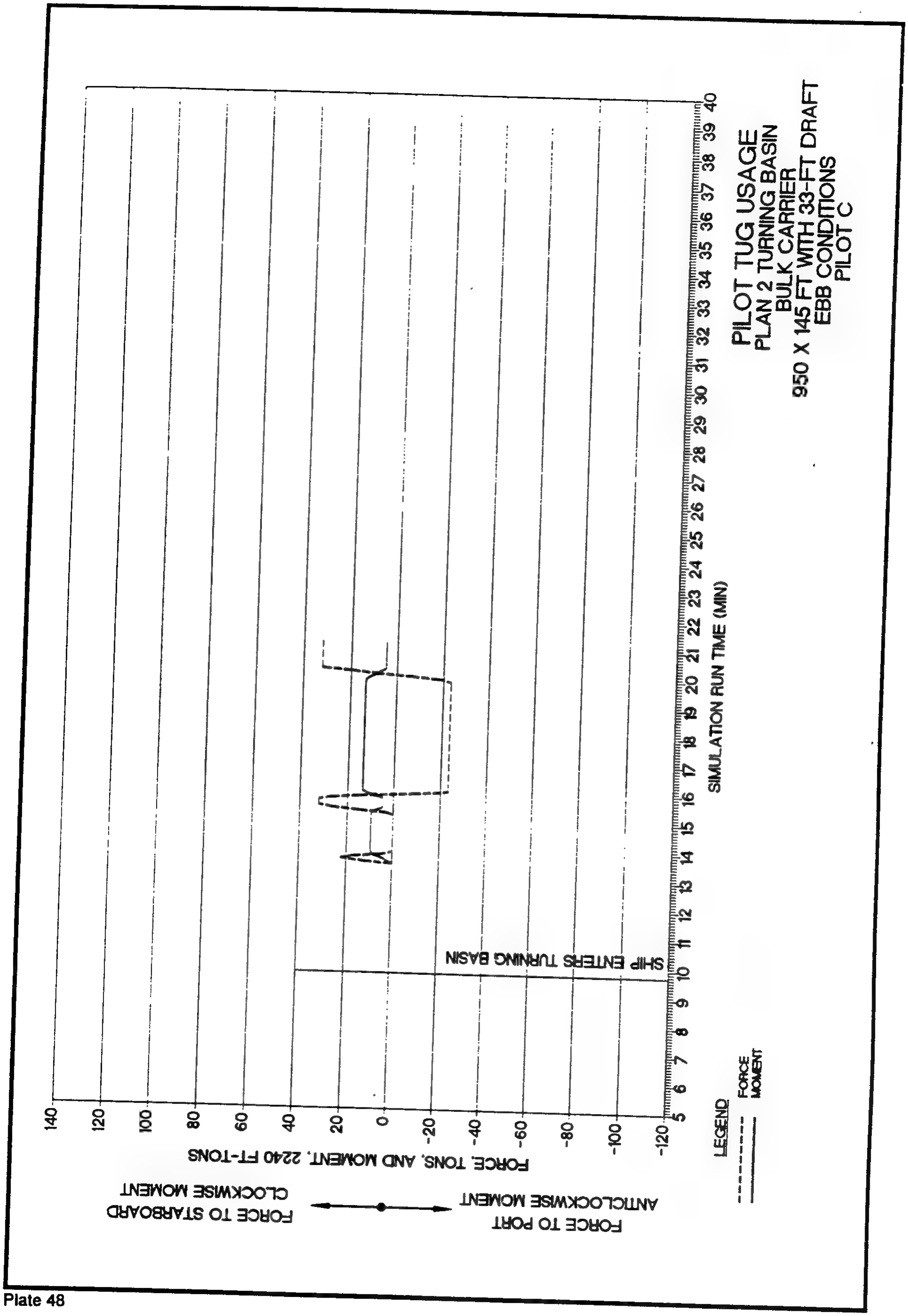
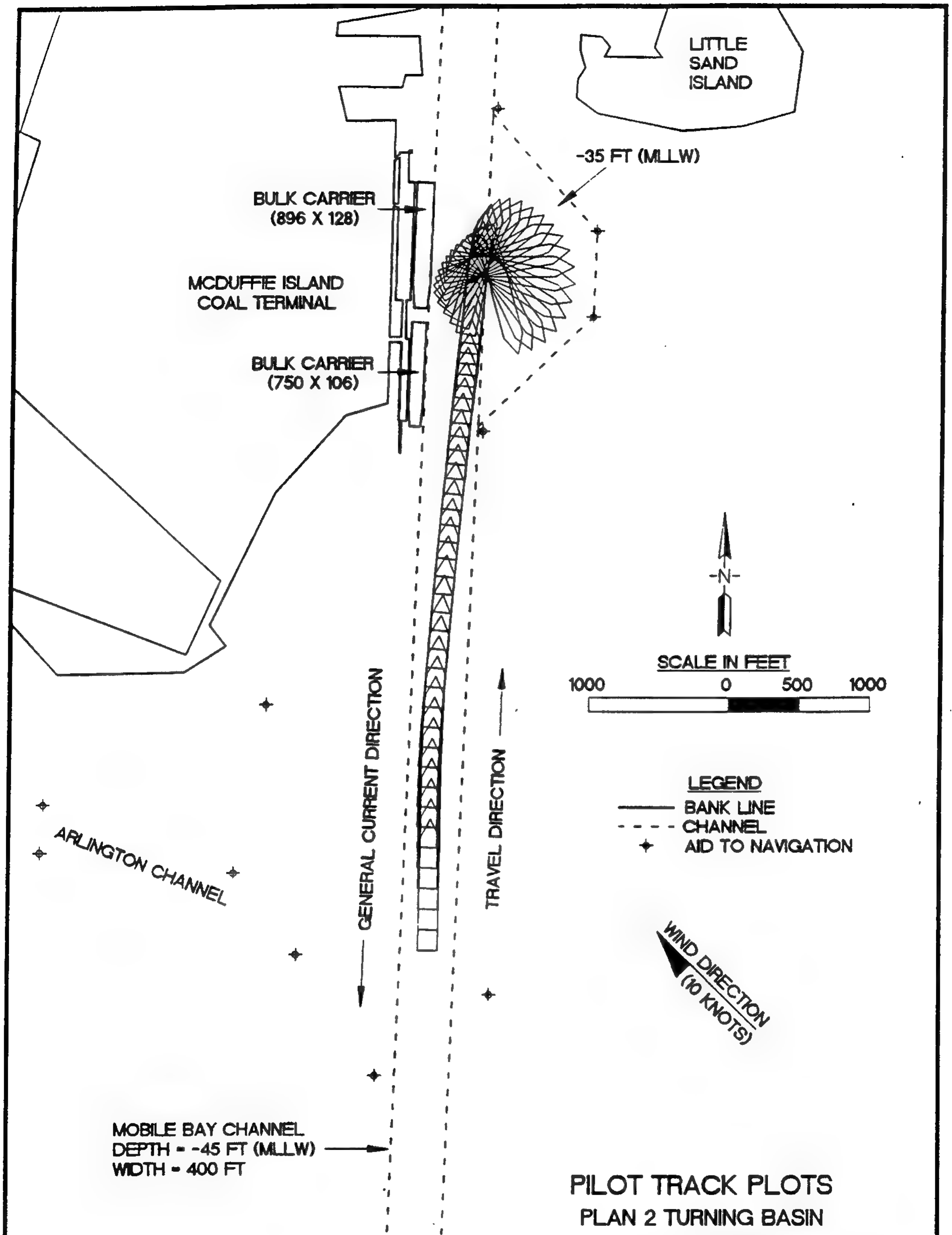
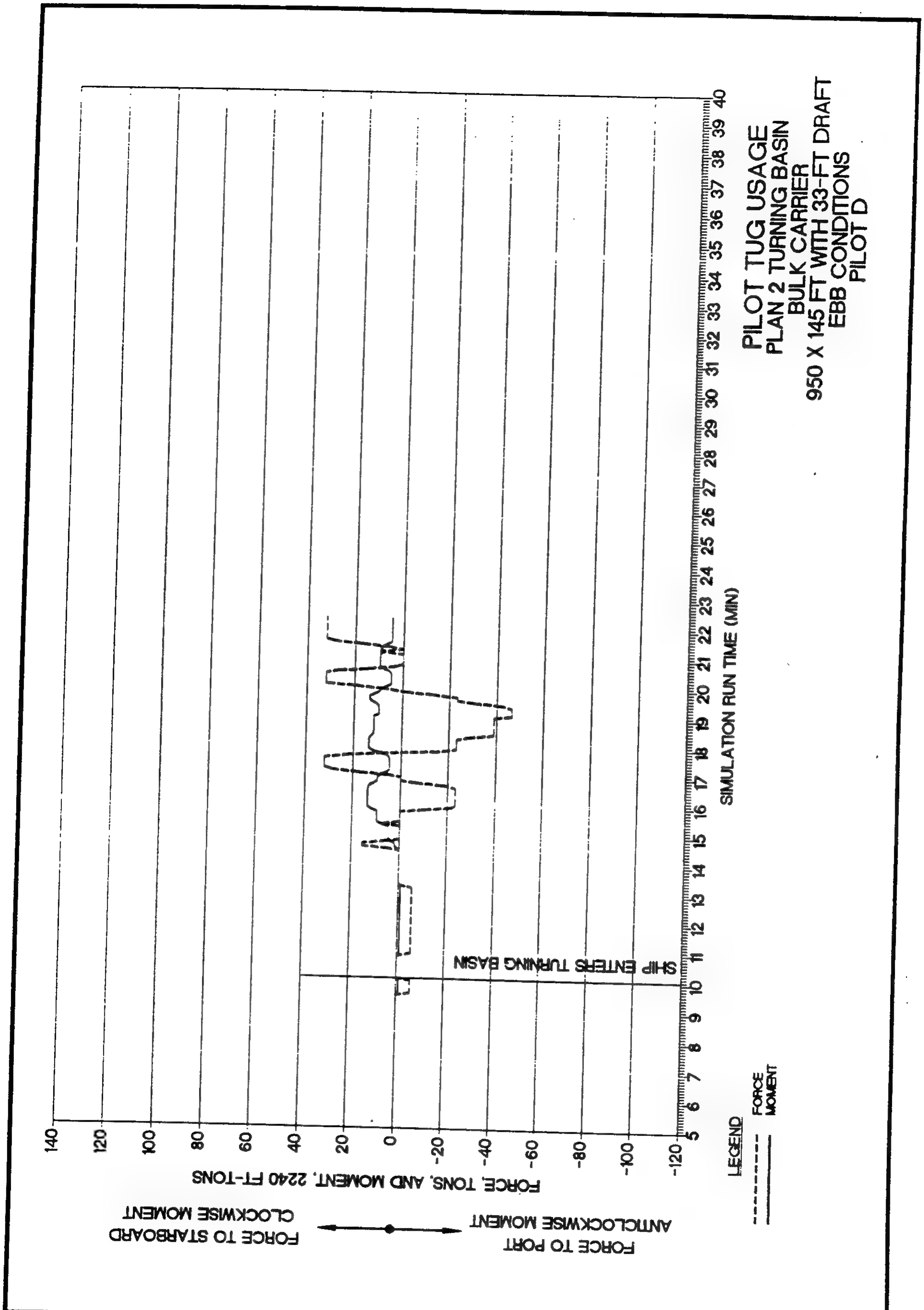
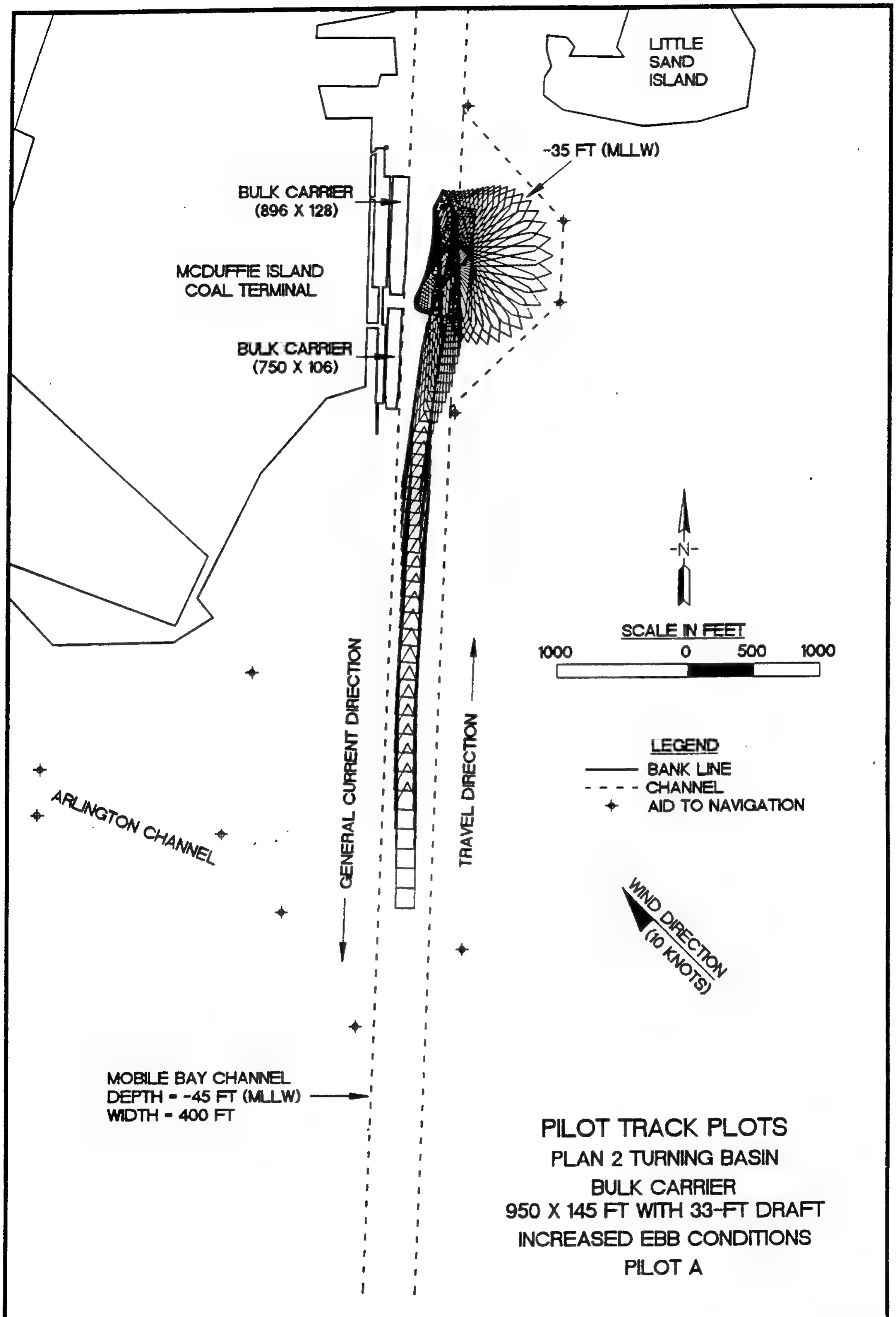

PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
EBB CONDITIONS
PILOT C
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
FORCE
MOMENT
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

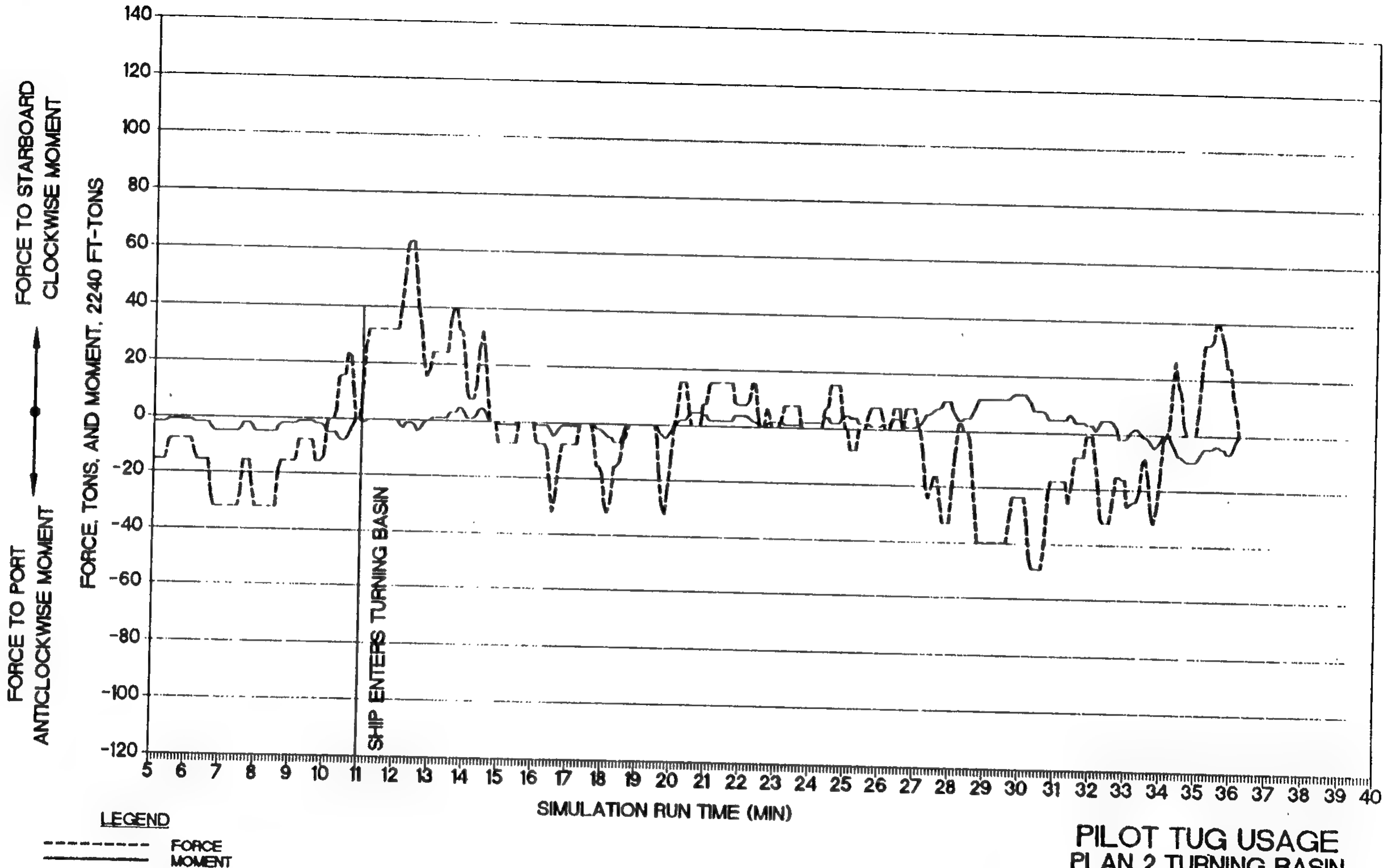
Plate 48


LITTLE
SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
SCALE IN FEET
1000
0
500
1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
EBB CONDITIONS
PILOT D

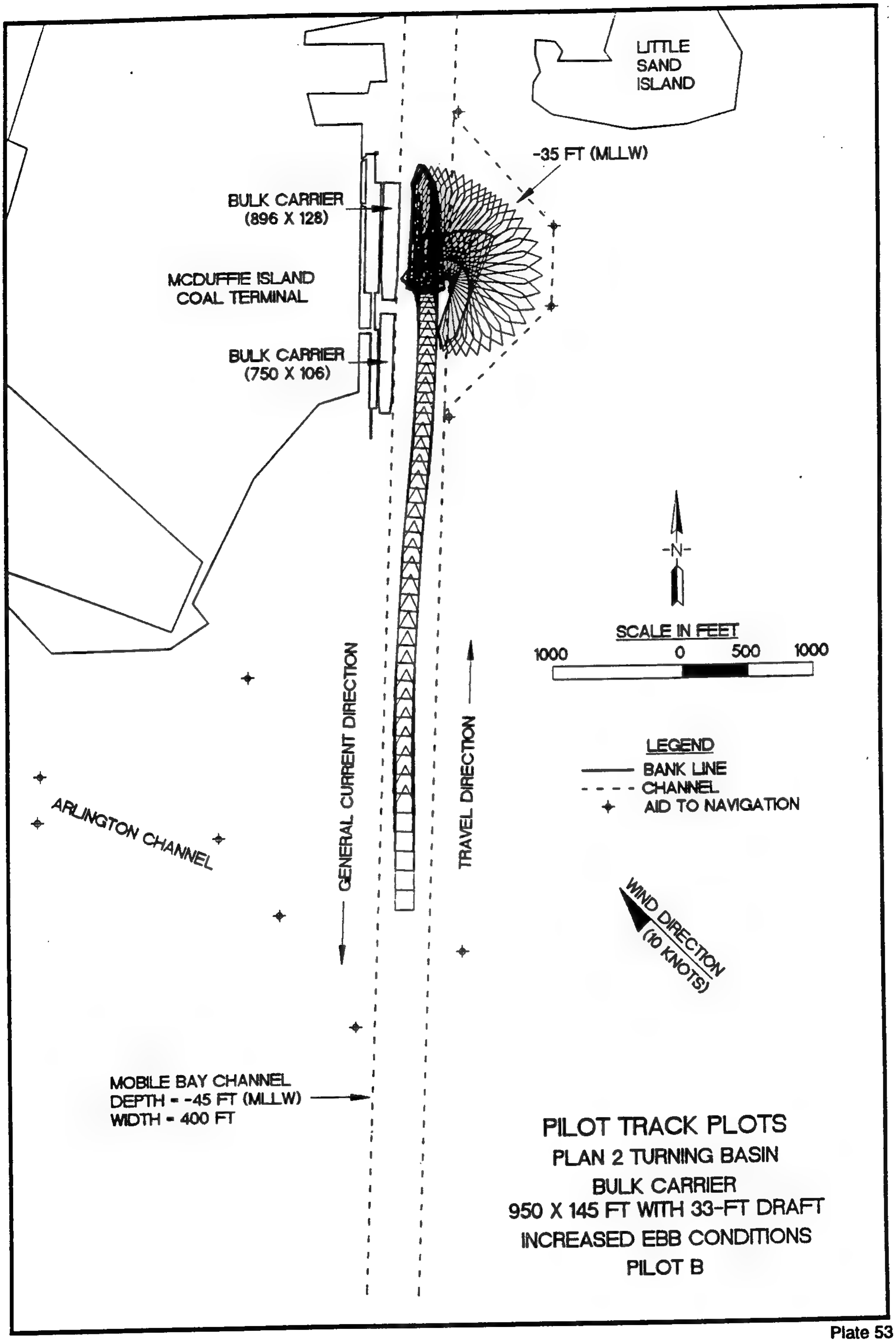

PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
EBB CONDITIONS
PILOT D
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
FORCE
MOMENT
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

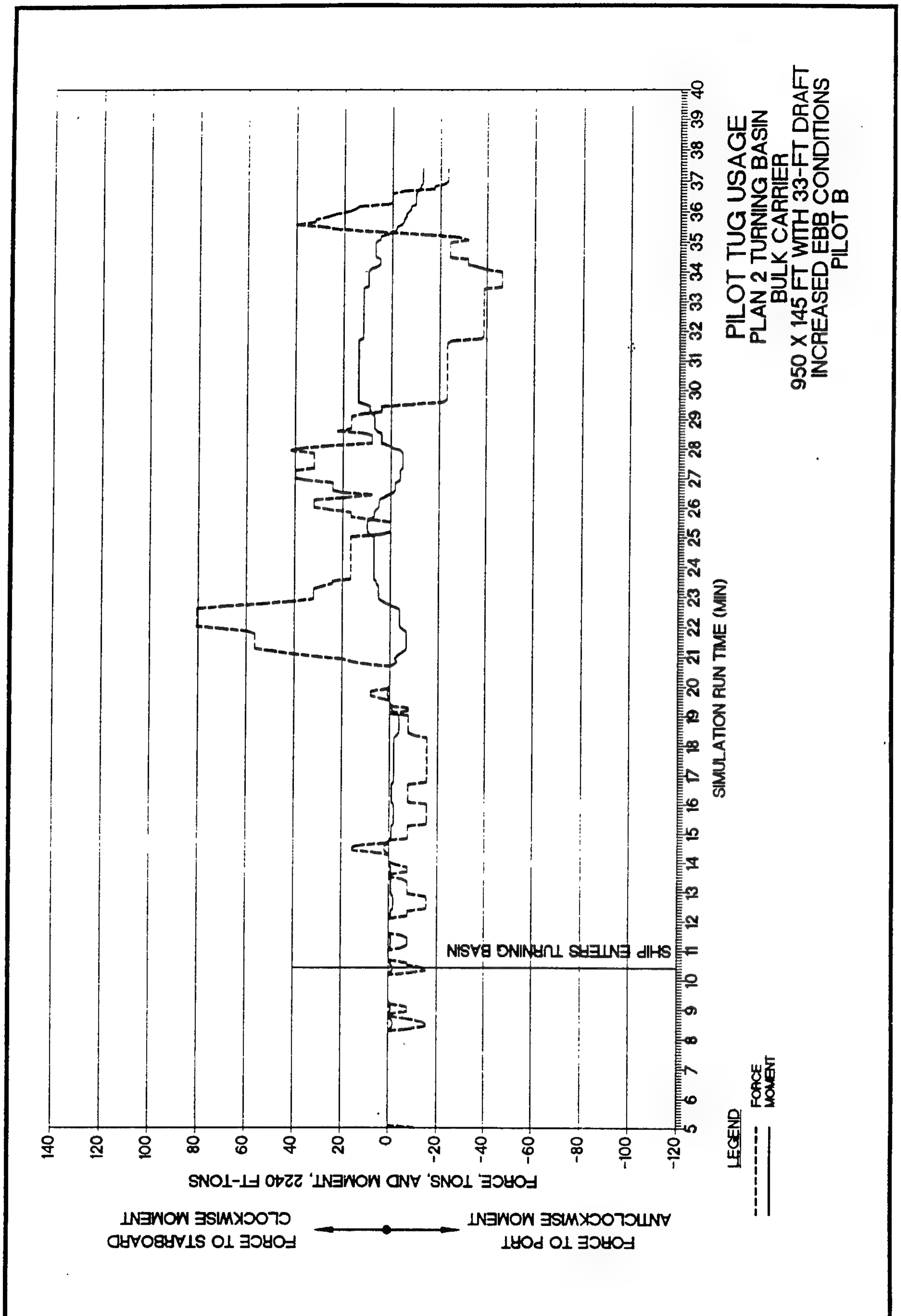


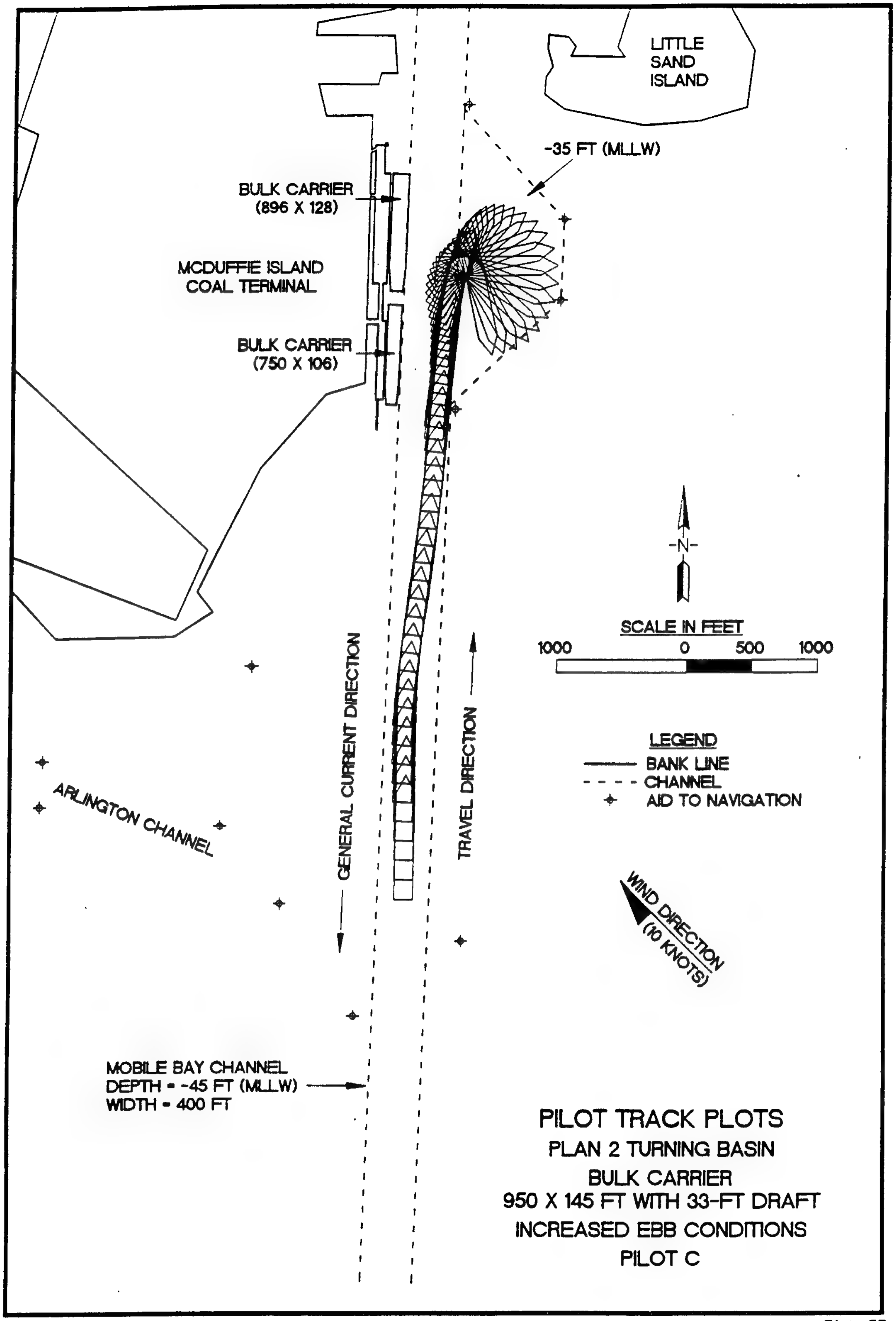
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT A



PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT A


LITTLE
SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
N
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT B


PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT B
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
FORCE
MOMENT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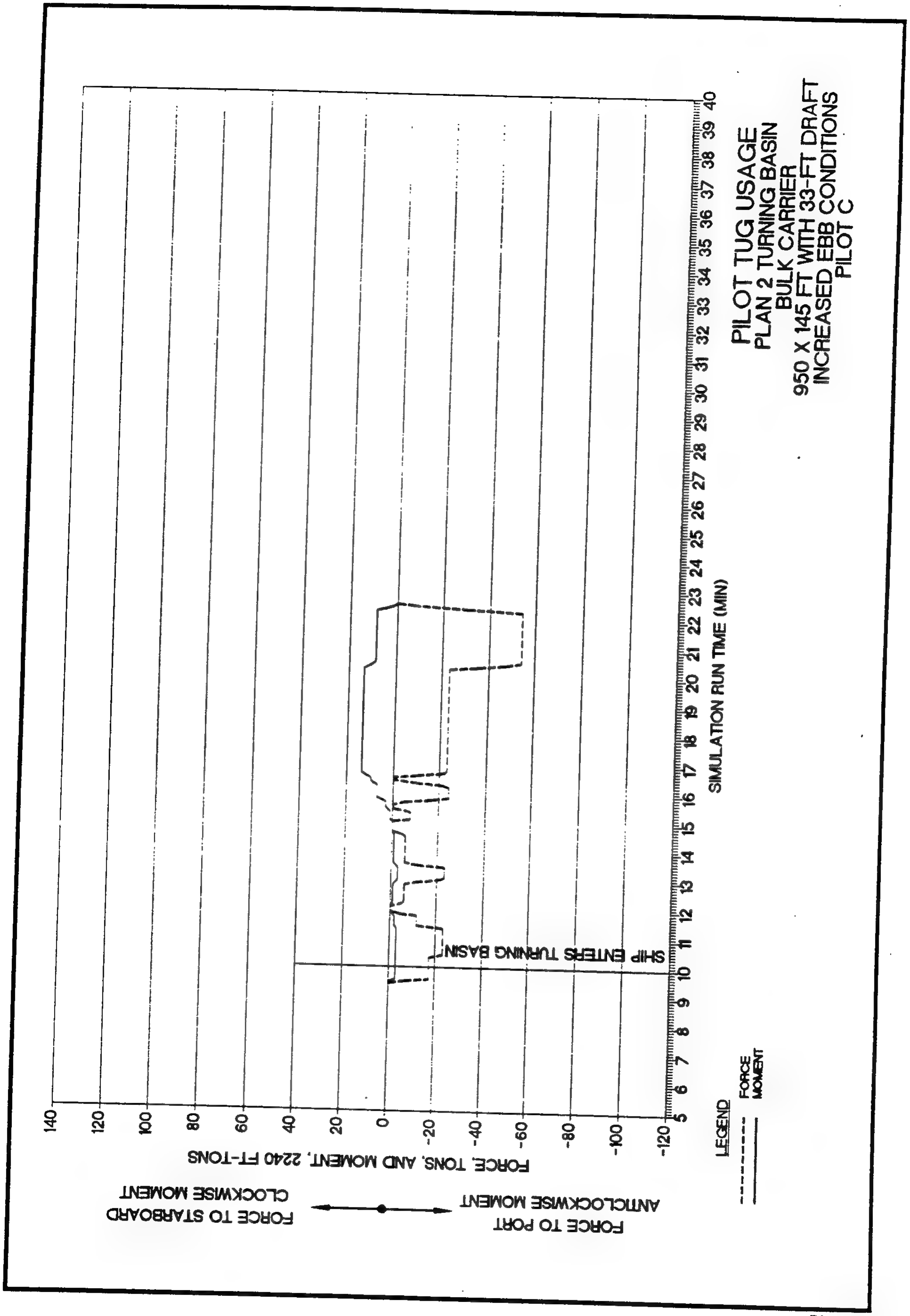
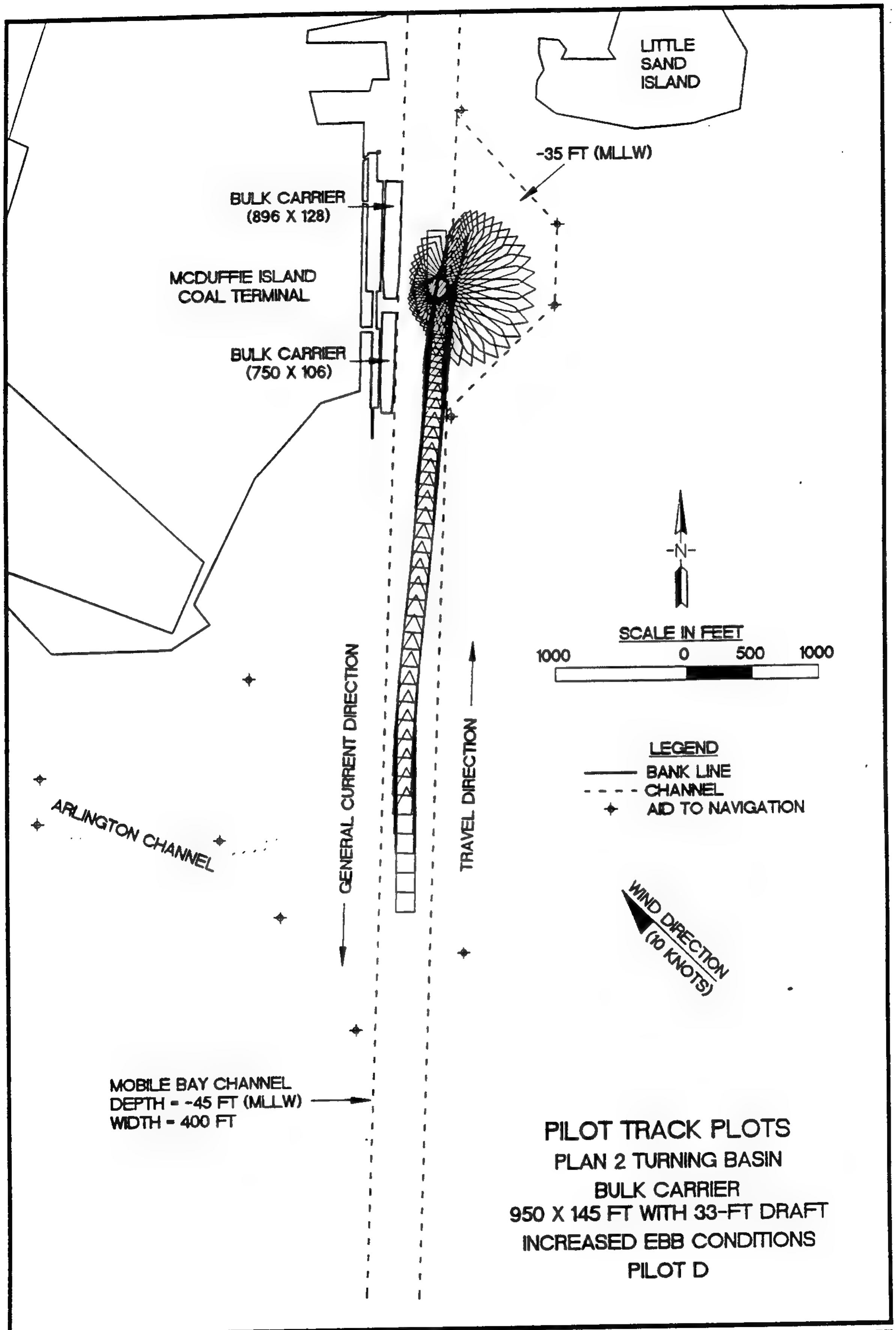
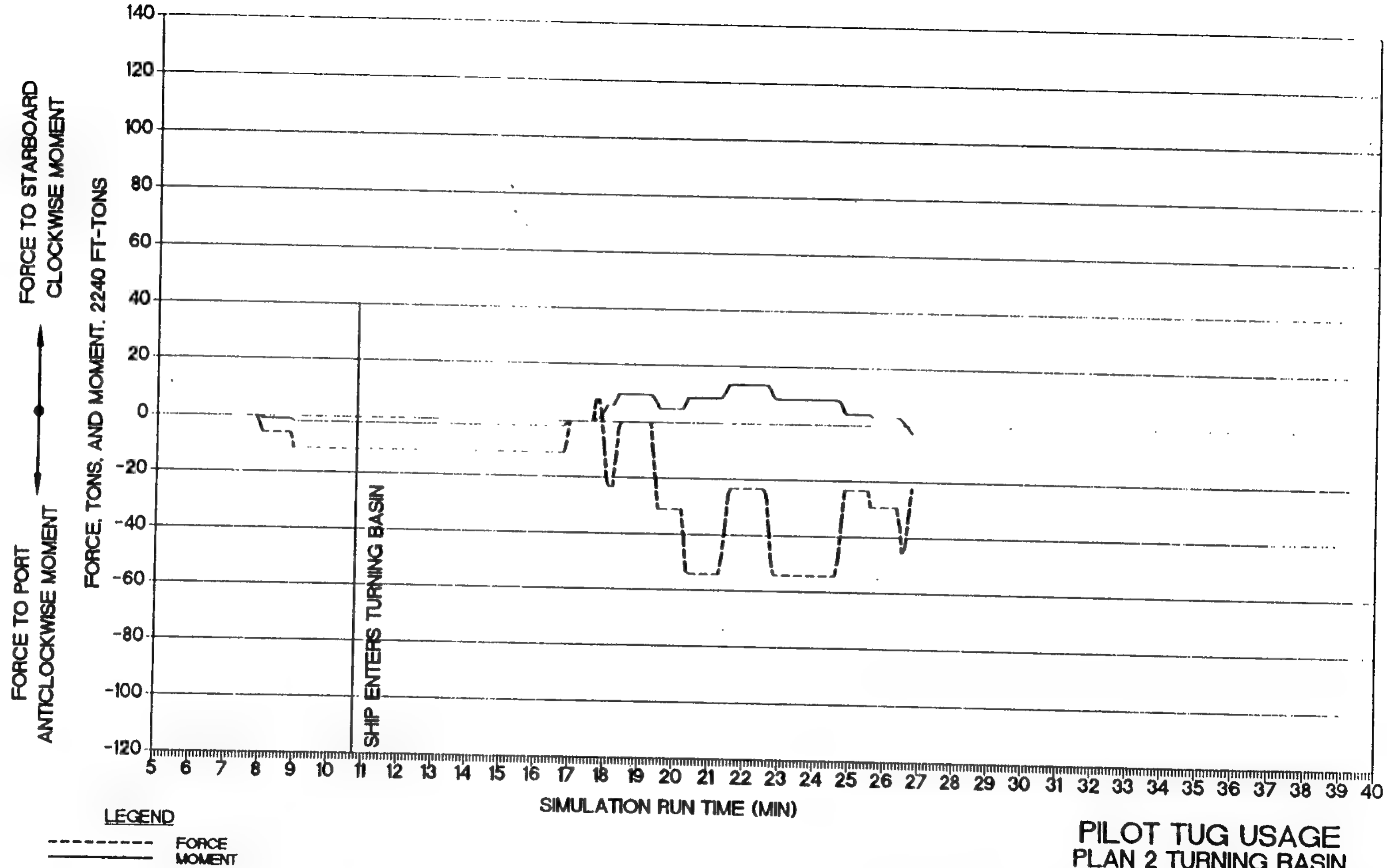
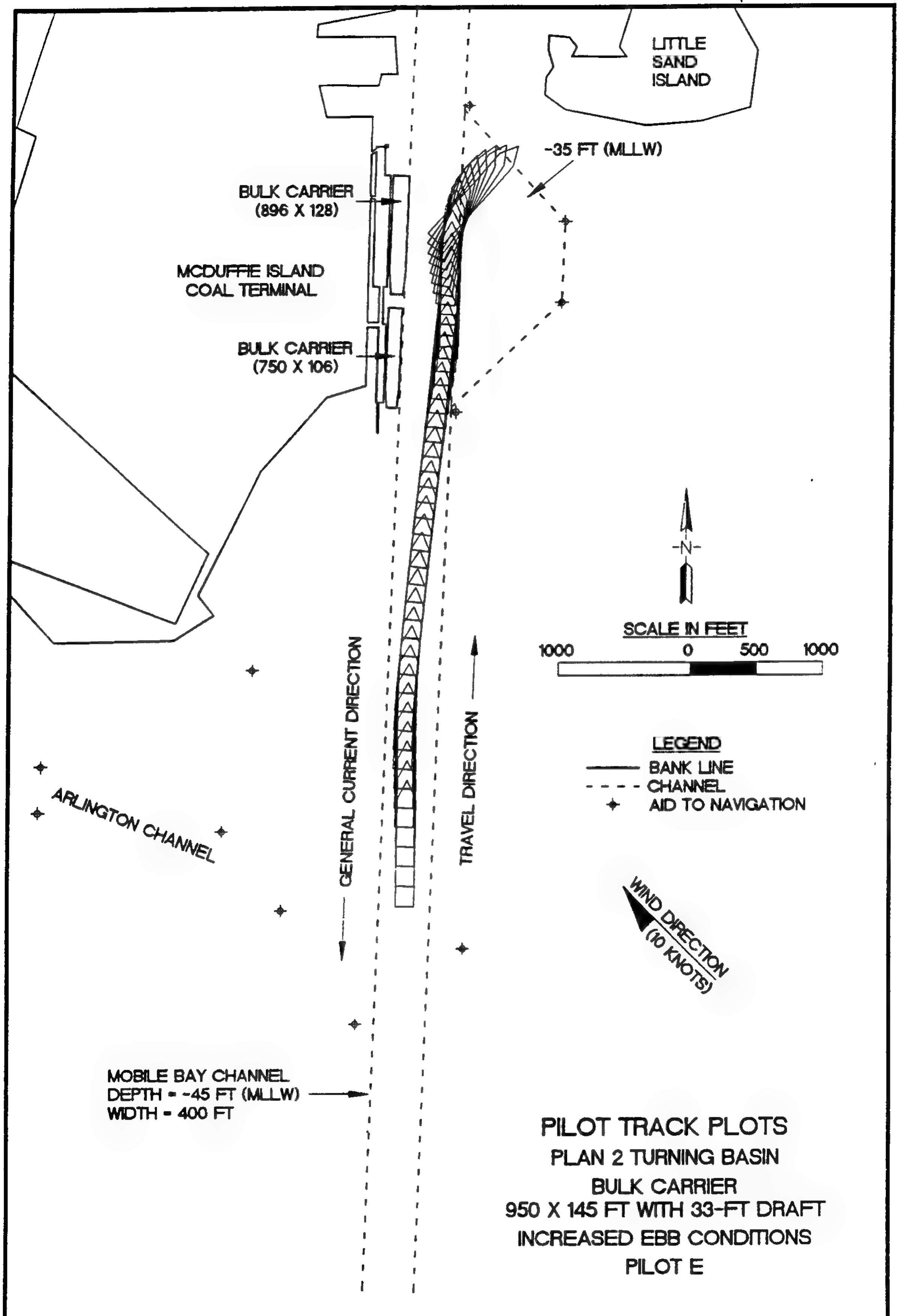
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
N
SCALE IN FEET
1000
0
500
1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT C


PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT C
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
FORCE
MOMENT

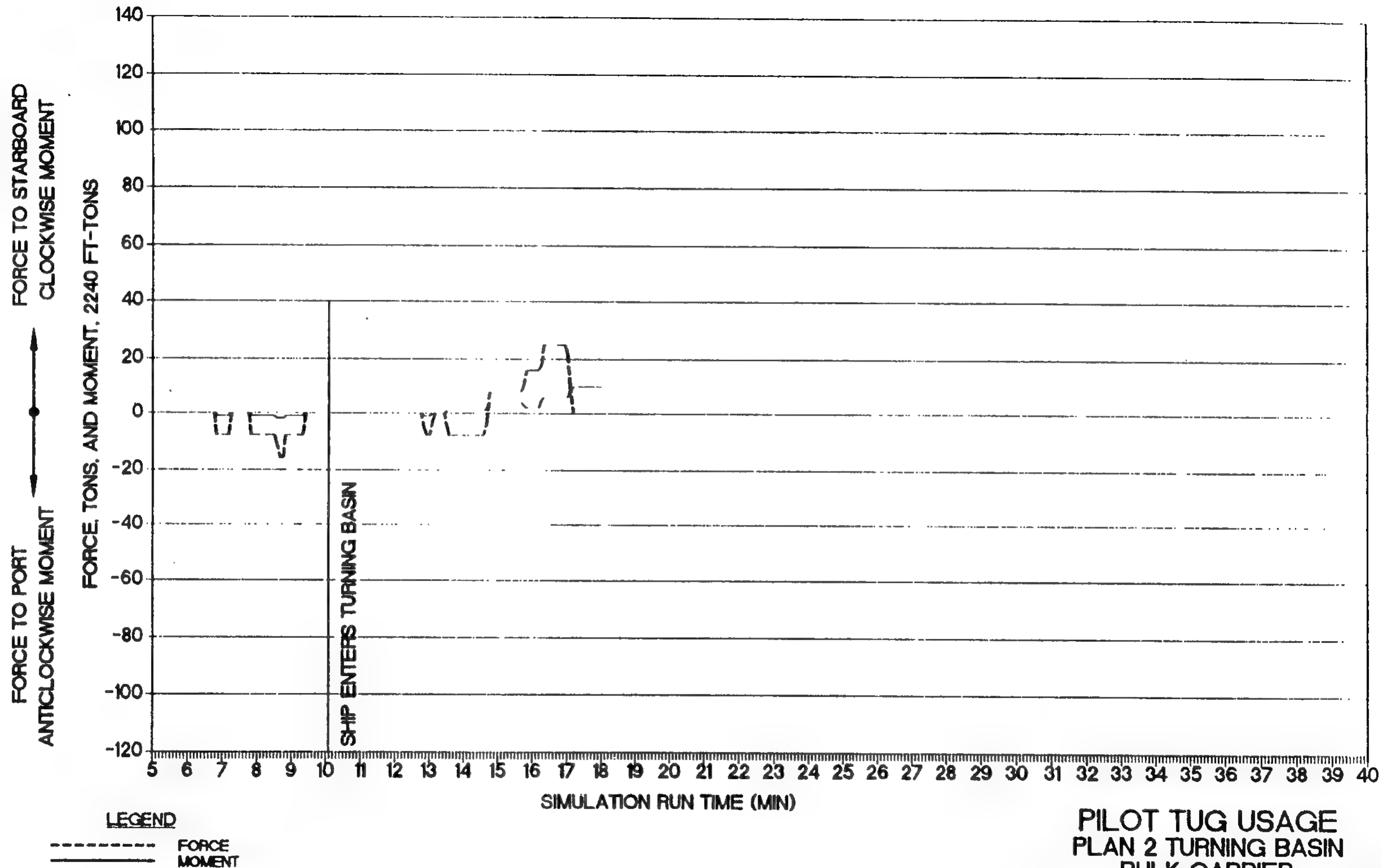

LITTLE SAND ISLAND
-35 FT (MLLW)
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT D



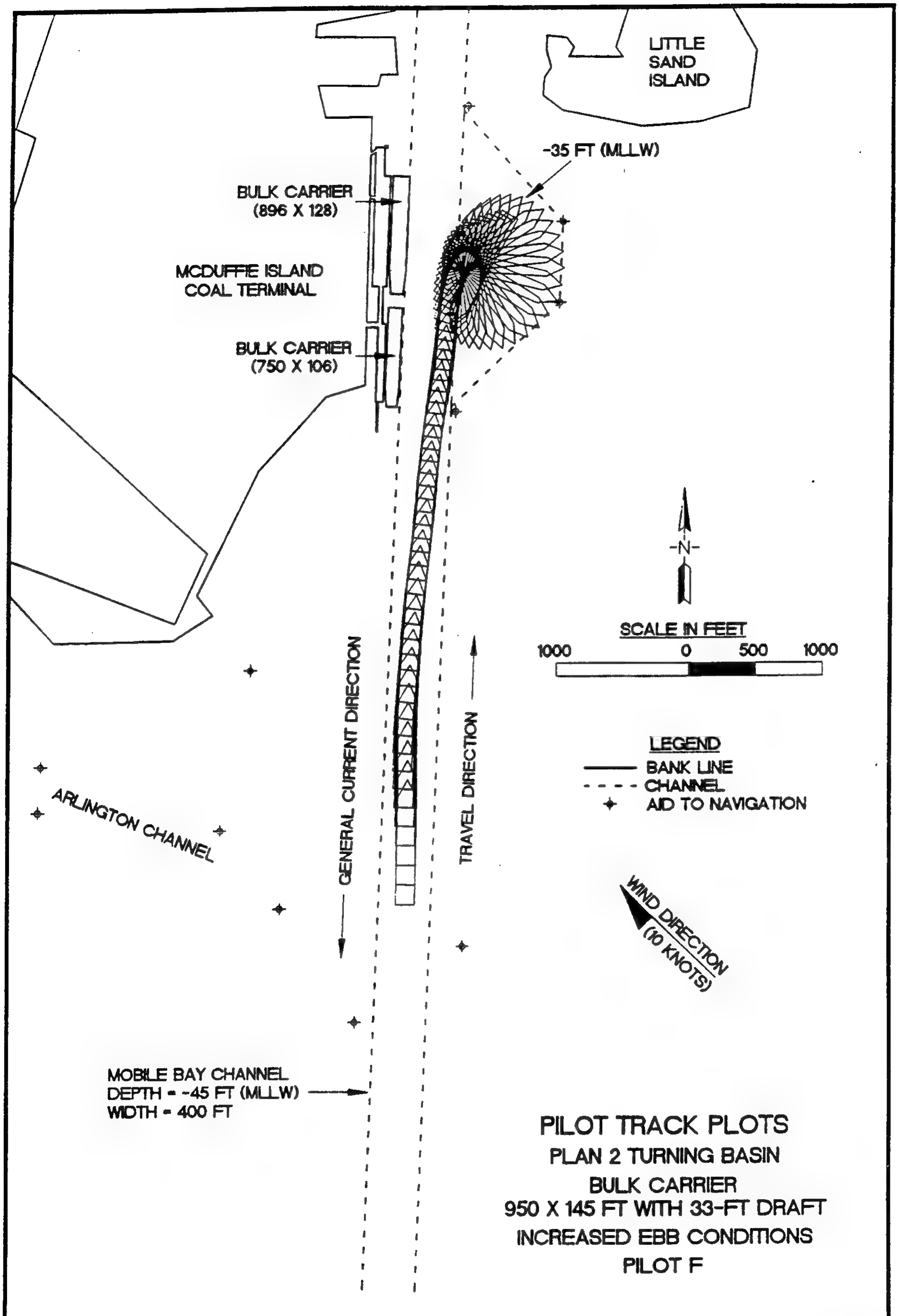
PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT D



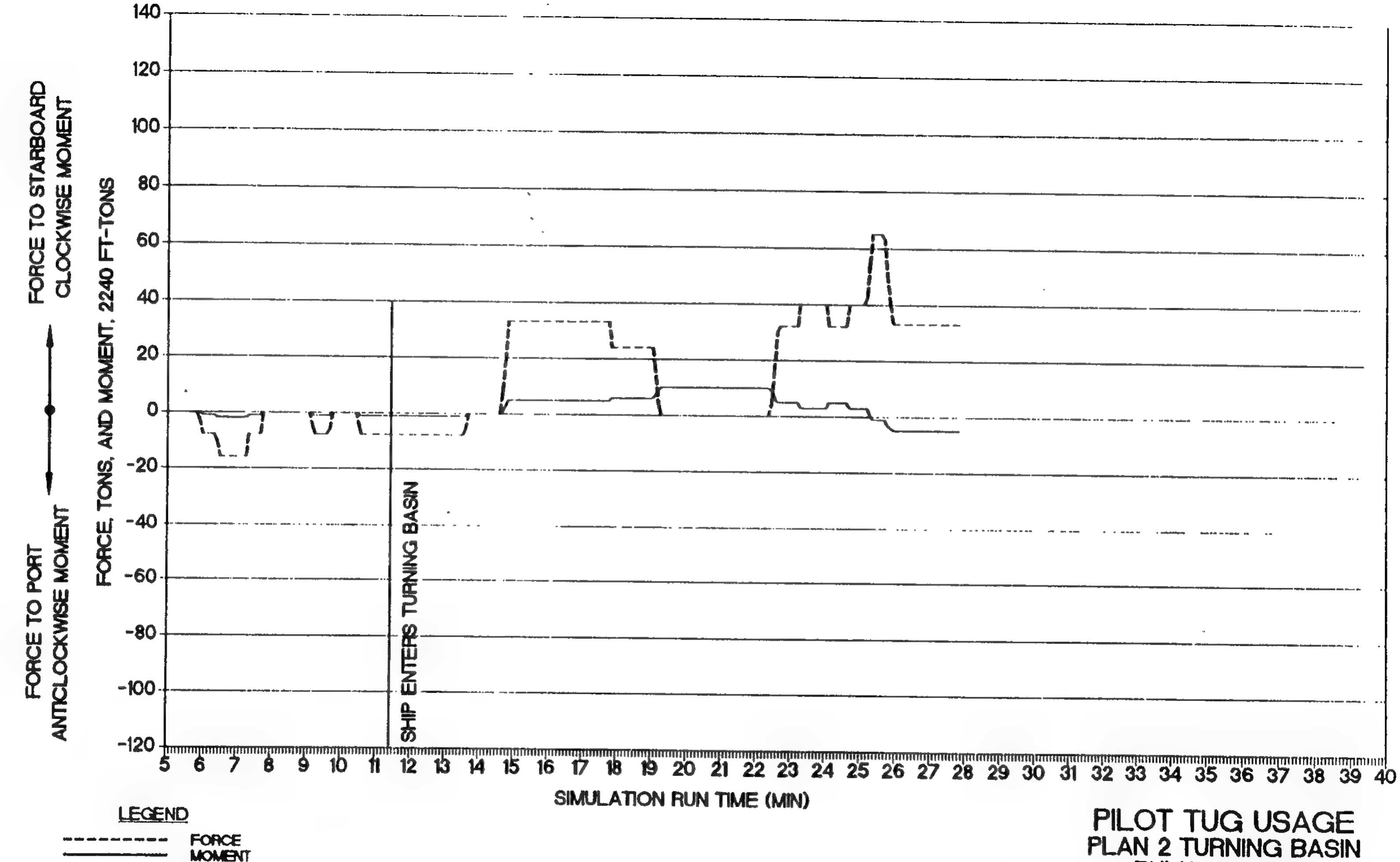
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT E



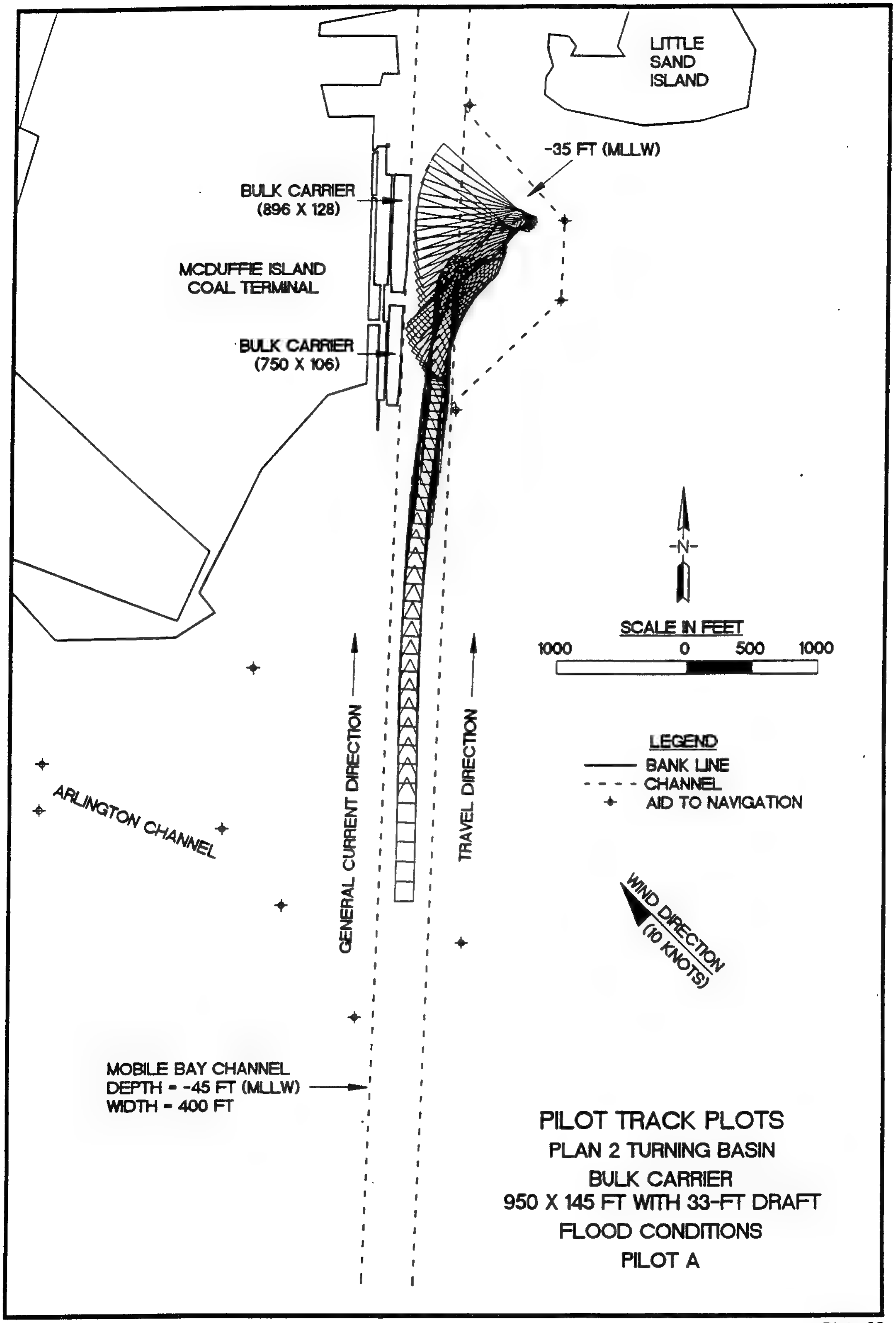
PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT E



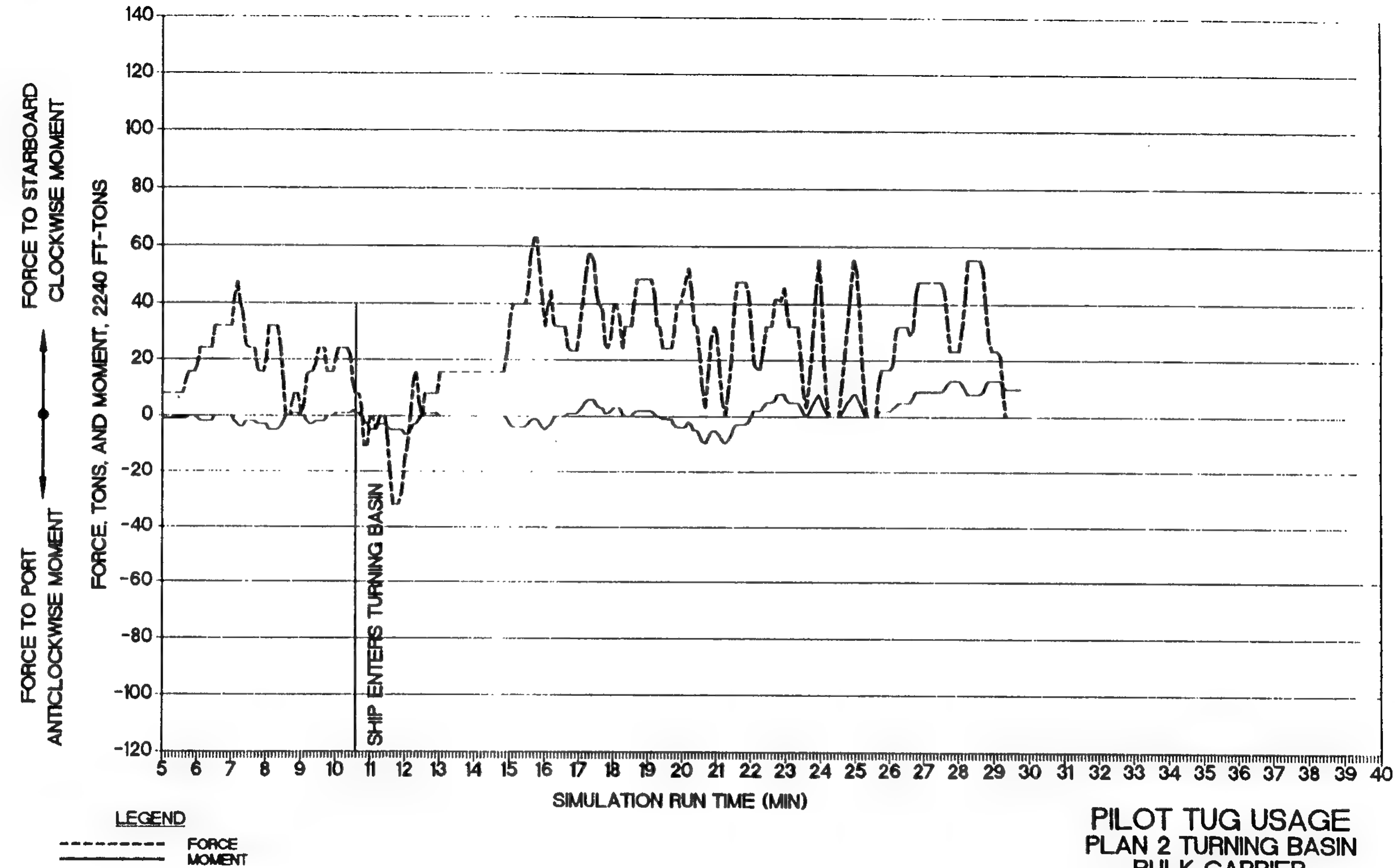
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT F



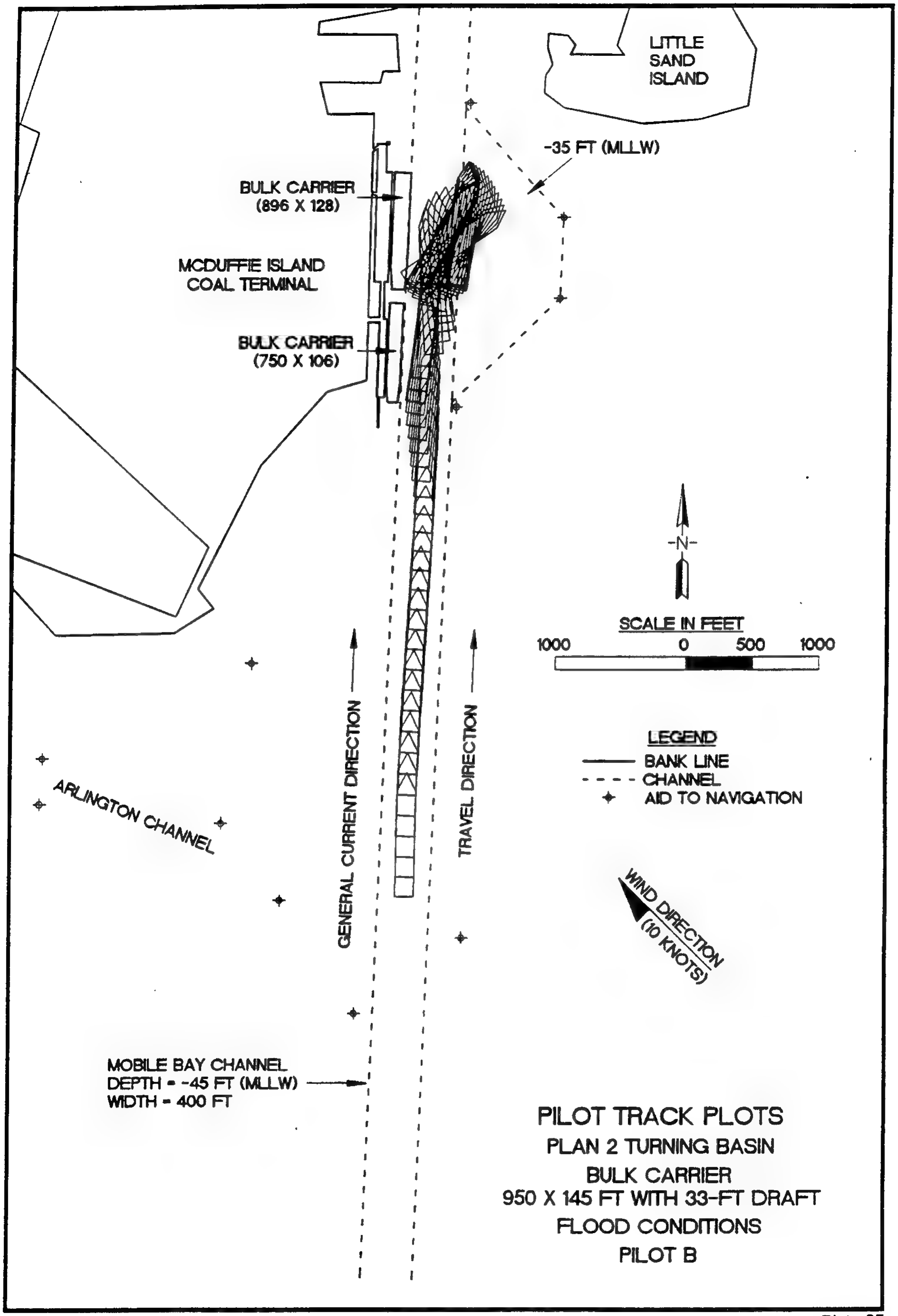
PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT F



LITTLE SAND ISLAND
-35 FT (MLLW)
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT A



PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT A


LITTLE
SAND
ISLAND
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BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000
0
500
1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
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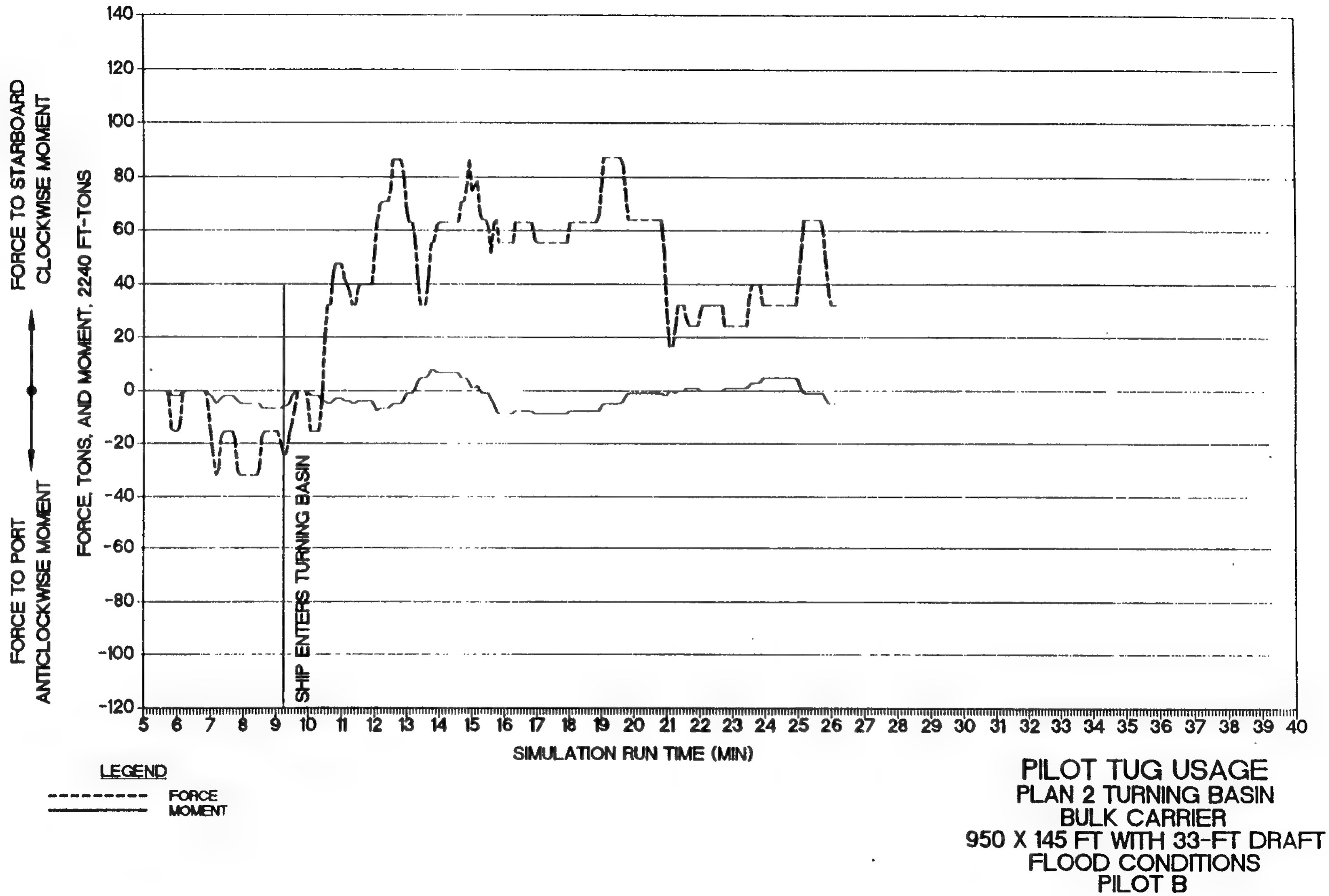
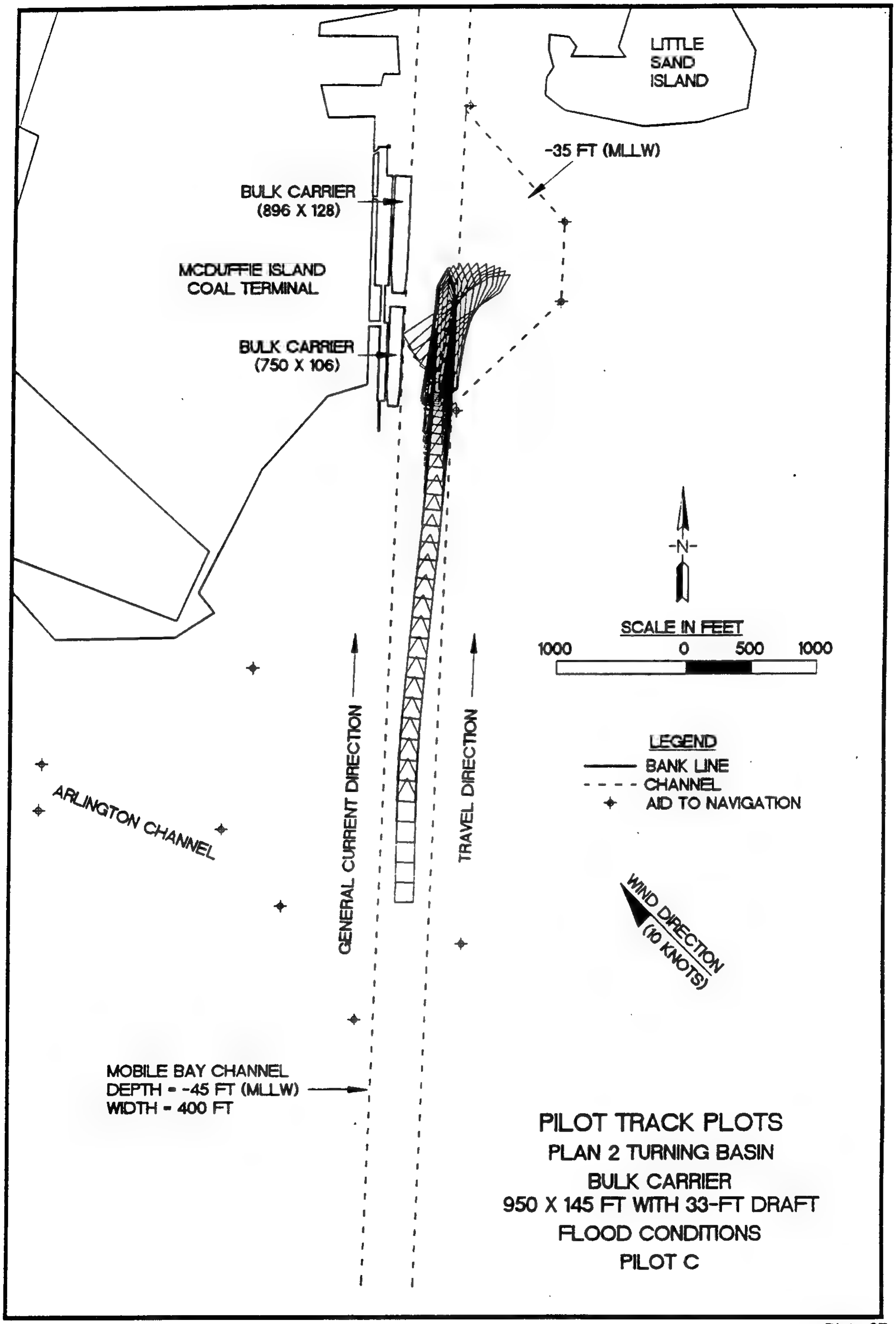
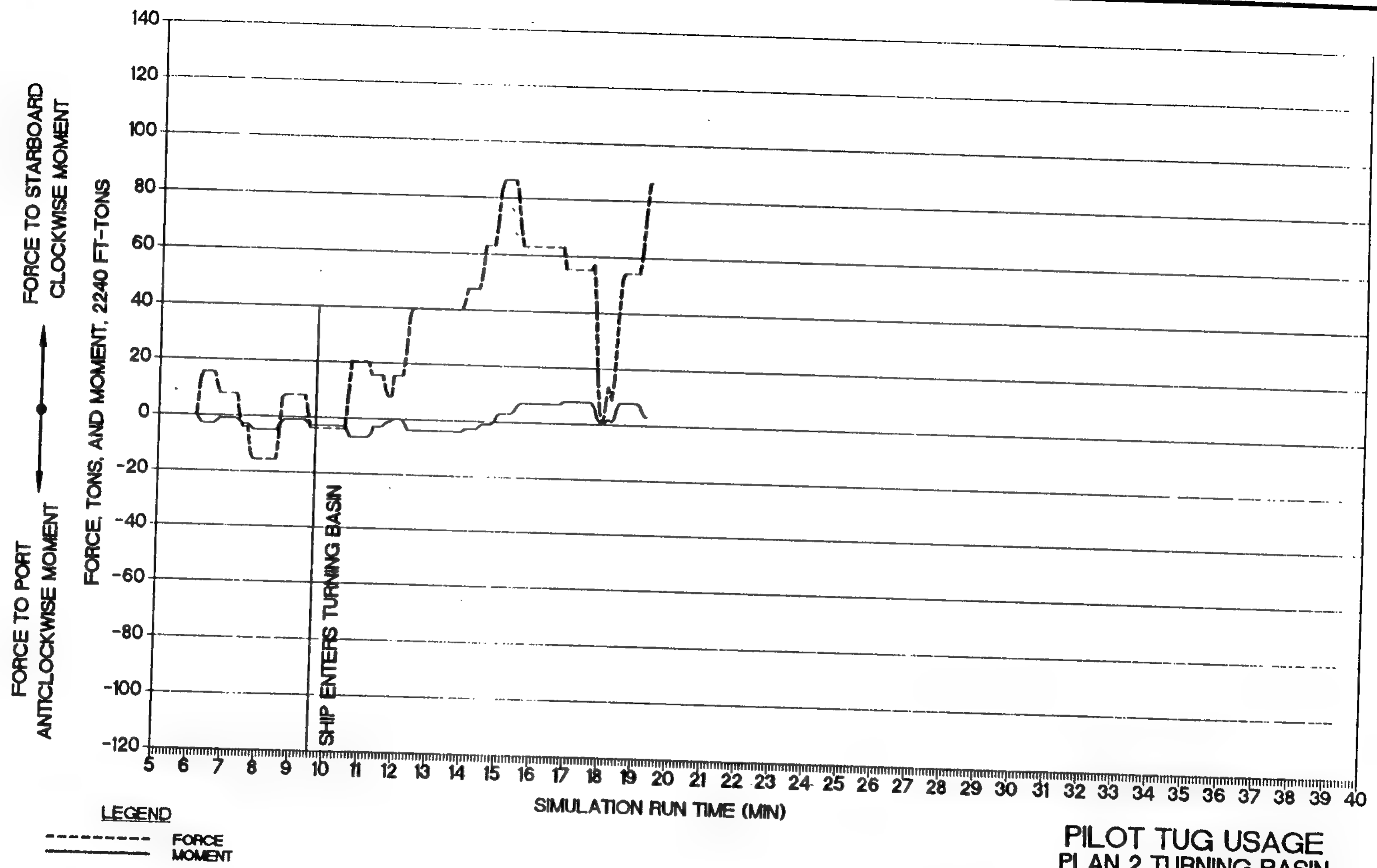
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT B

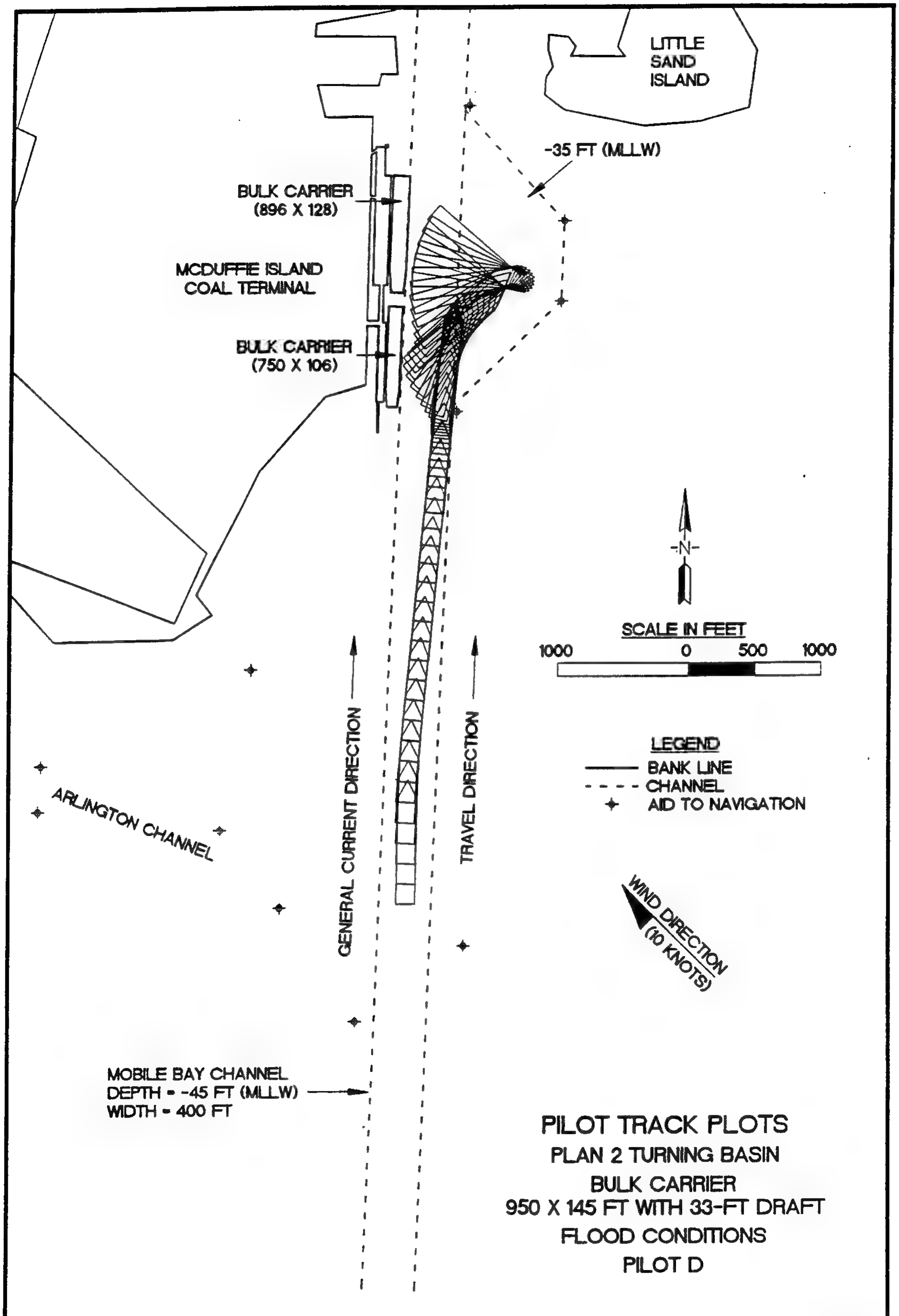


FORCE TO STARBOARD
CLOCKWISE MOMENT
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE, TONS, AND MOMENT, 2240 FT-TONS
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
SHIP ENTERS TURNING BASIN
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
SIMULATION RUN TIME (MIN)
LEGEND
FORCE
MOMENT
PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT B


LITTLE SAND ISLAND
-35 FT (MLLW)
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT C



PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT C


LITTLE SAND ISLAND
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BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT D

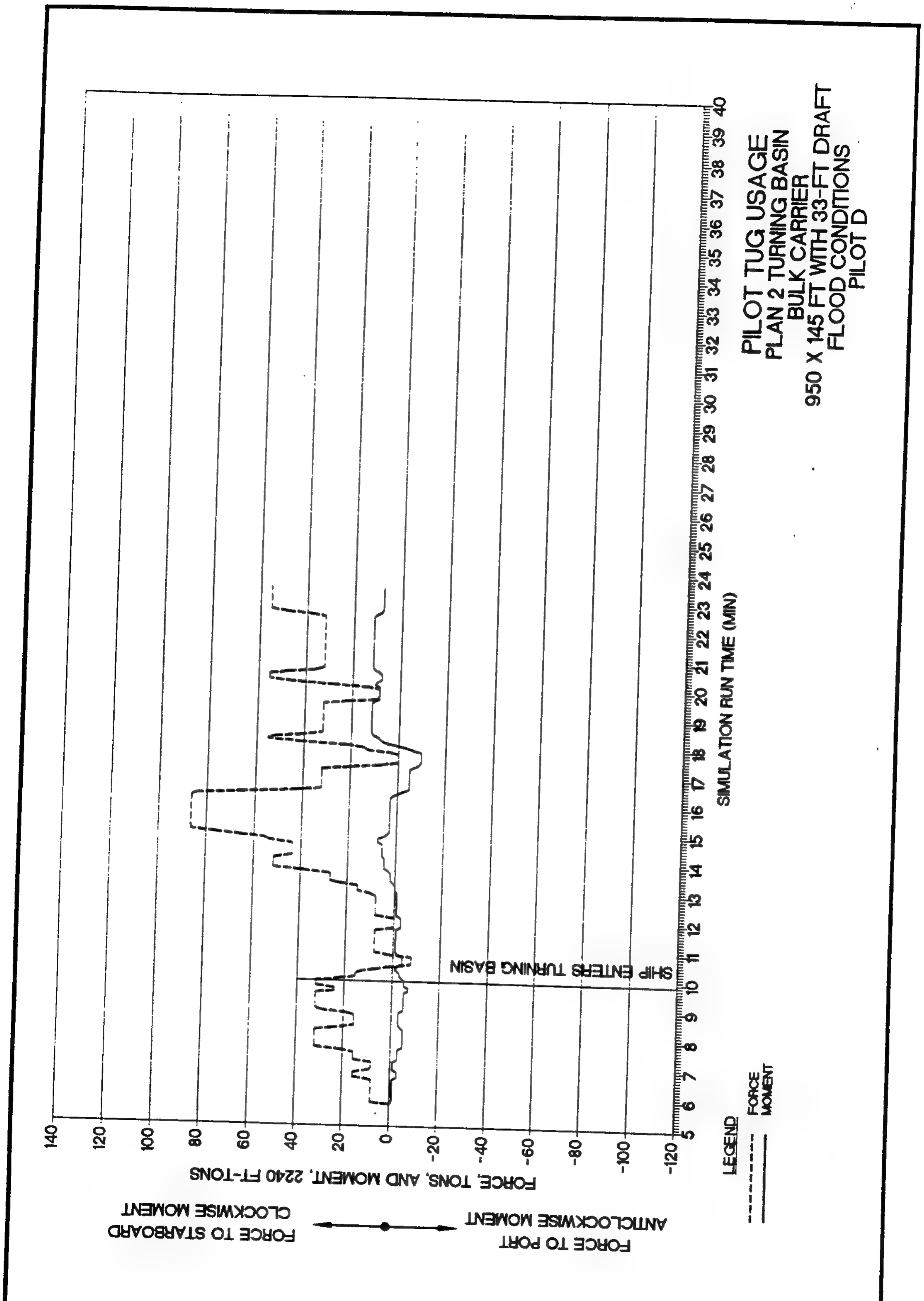
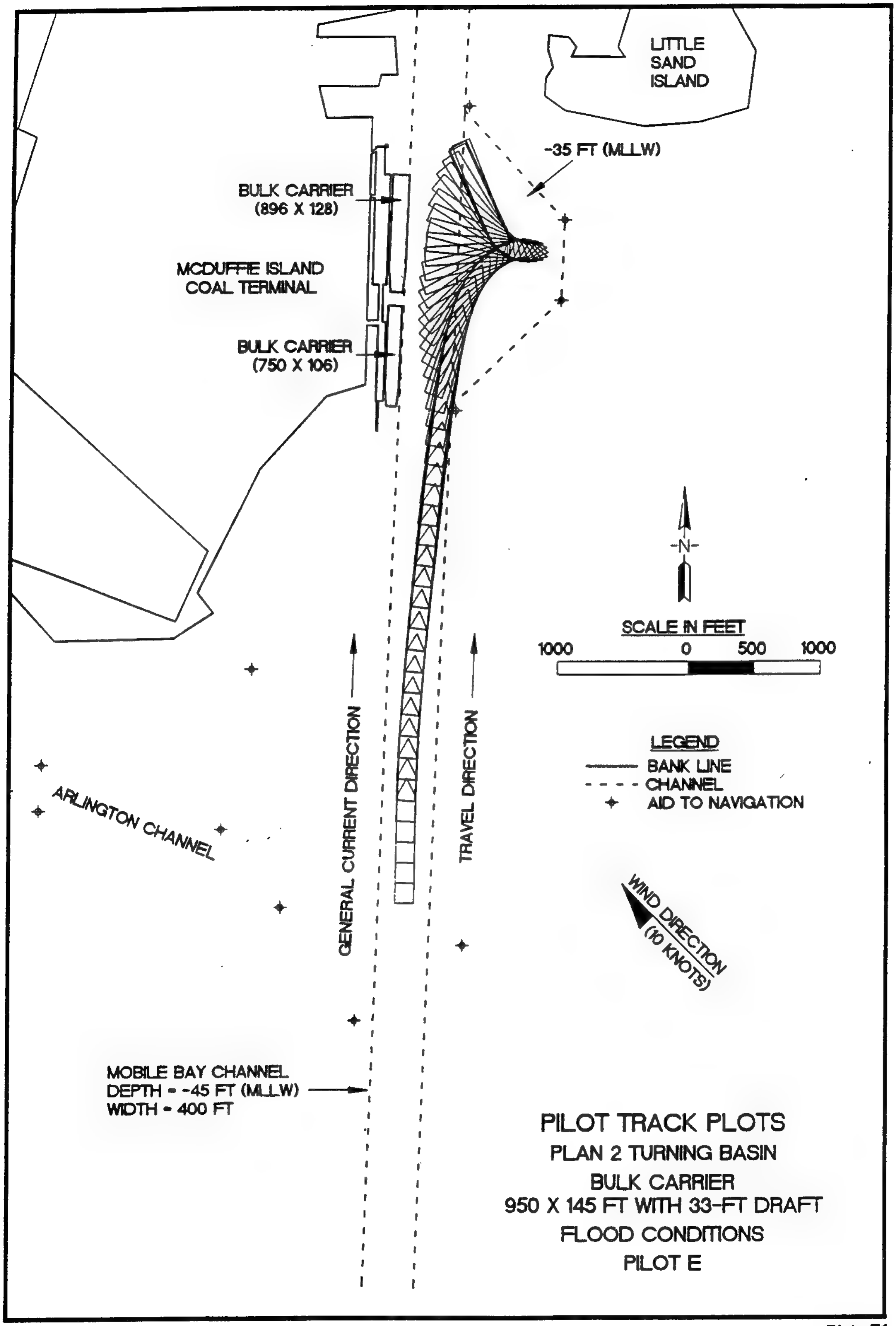

PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT D
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
SHIP ENTERS TURNING BASIN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
LEGEND
FORCE
MOMENT
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

Plate 70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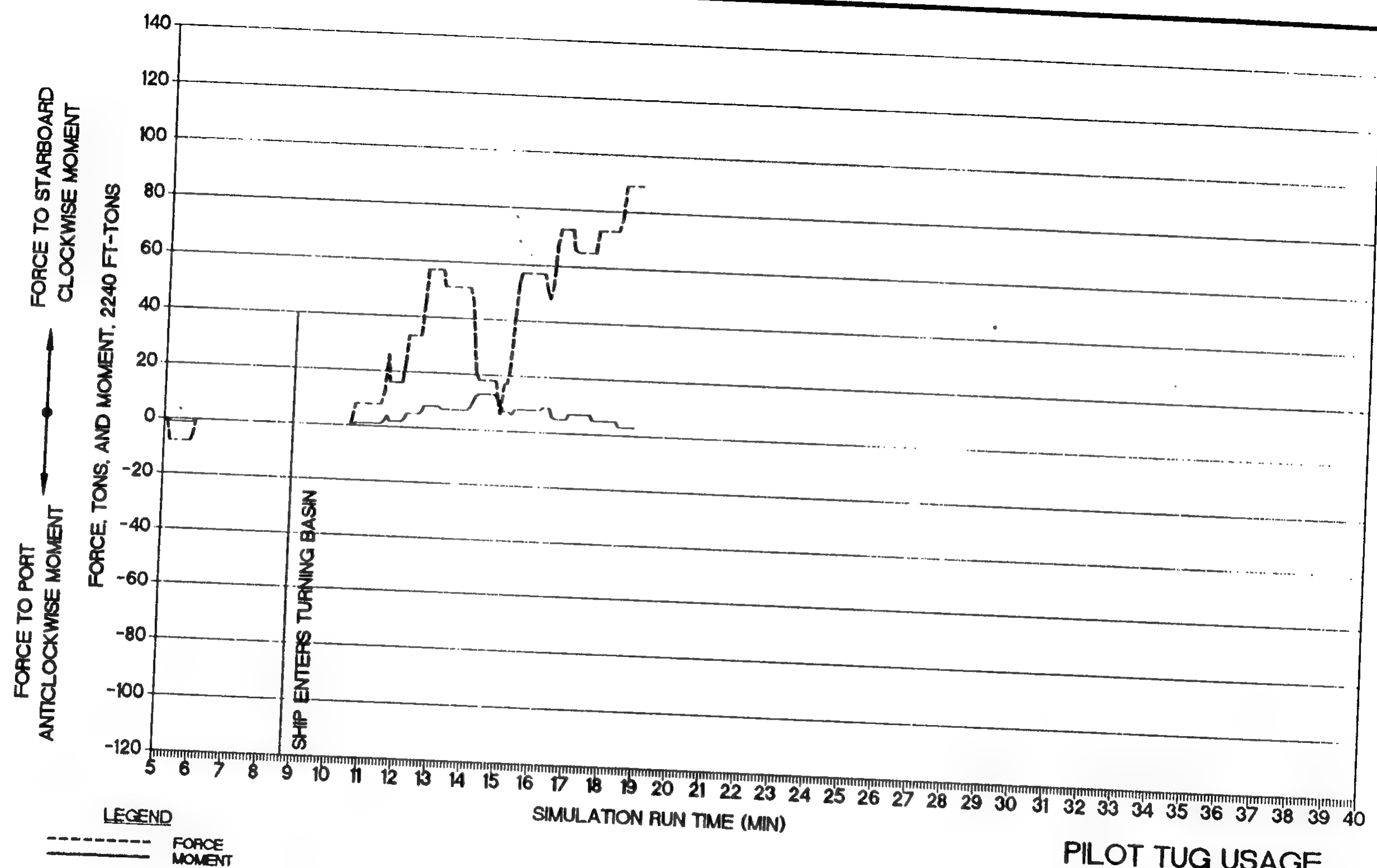
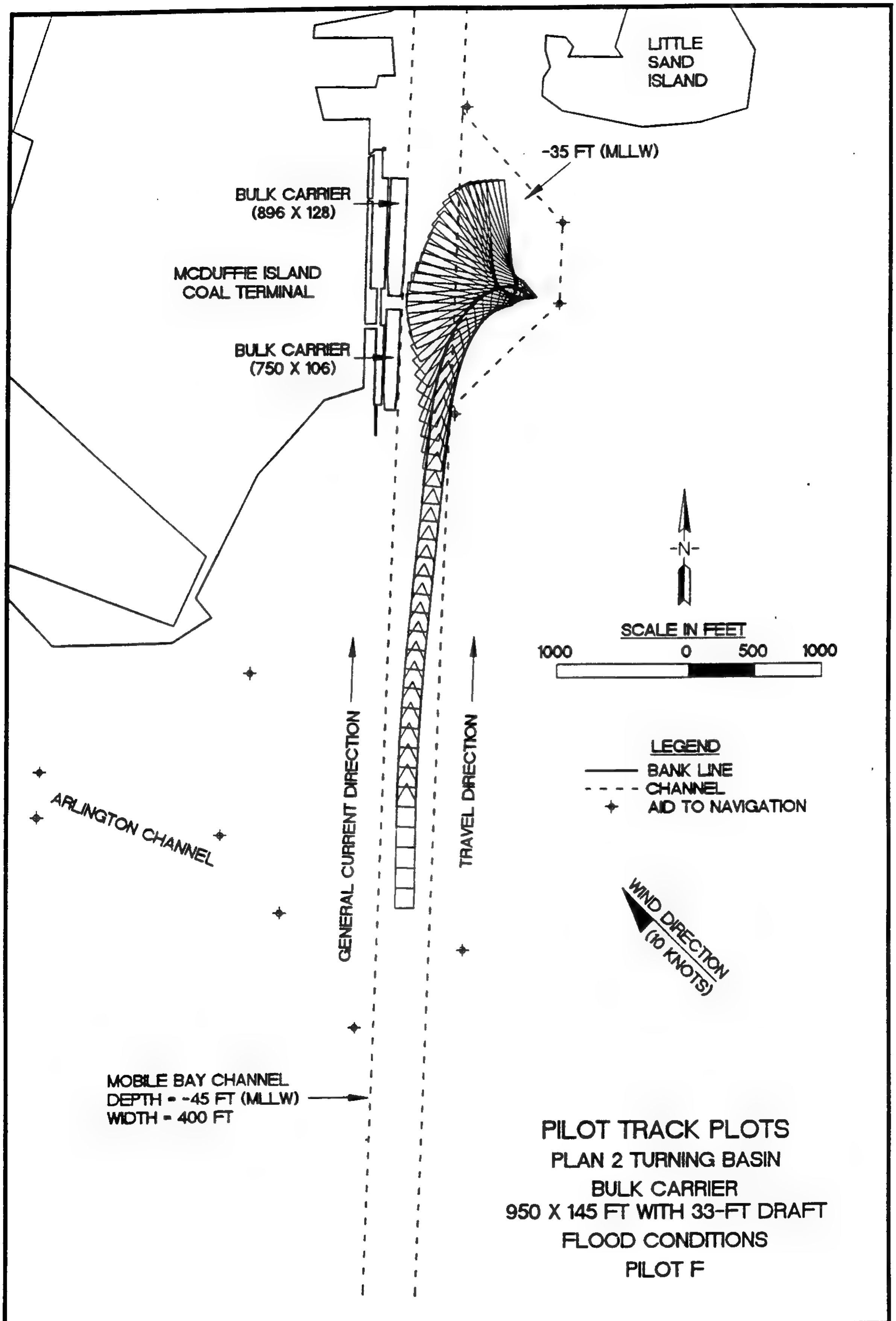
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000
0
500
1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT E



PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT E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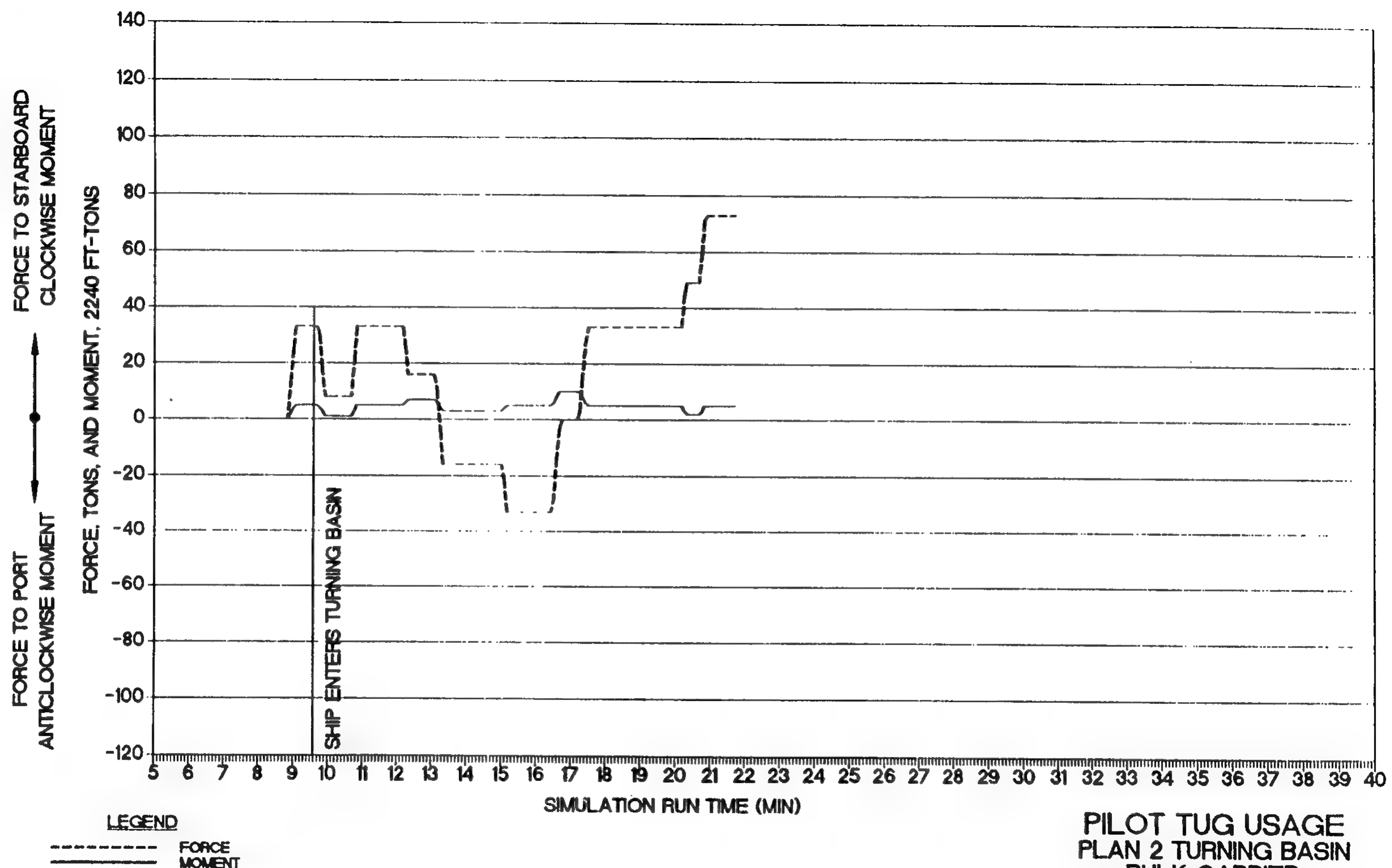
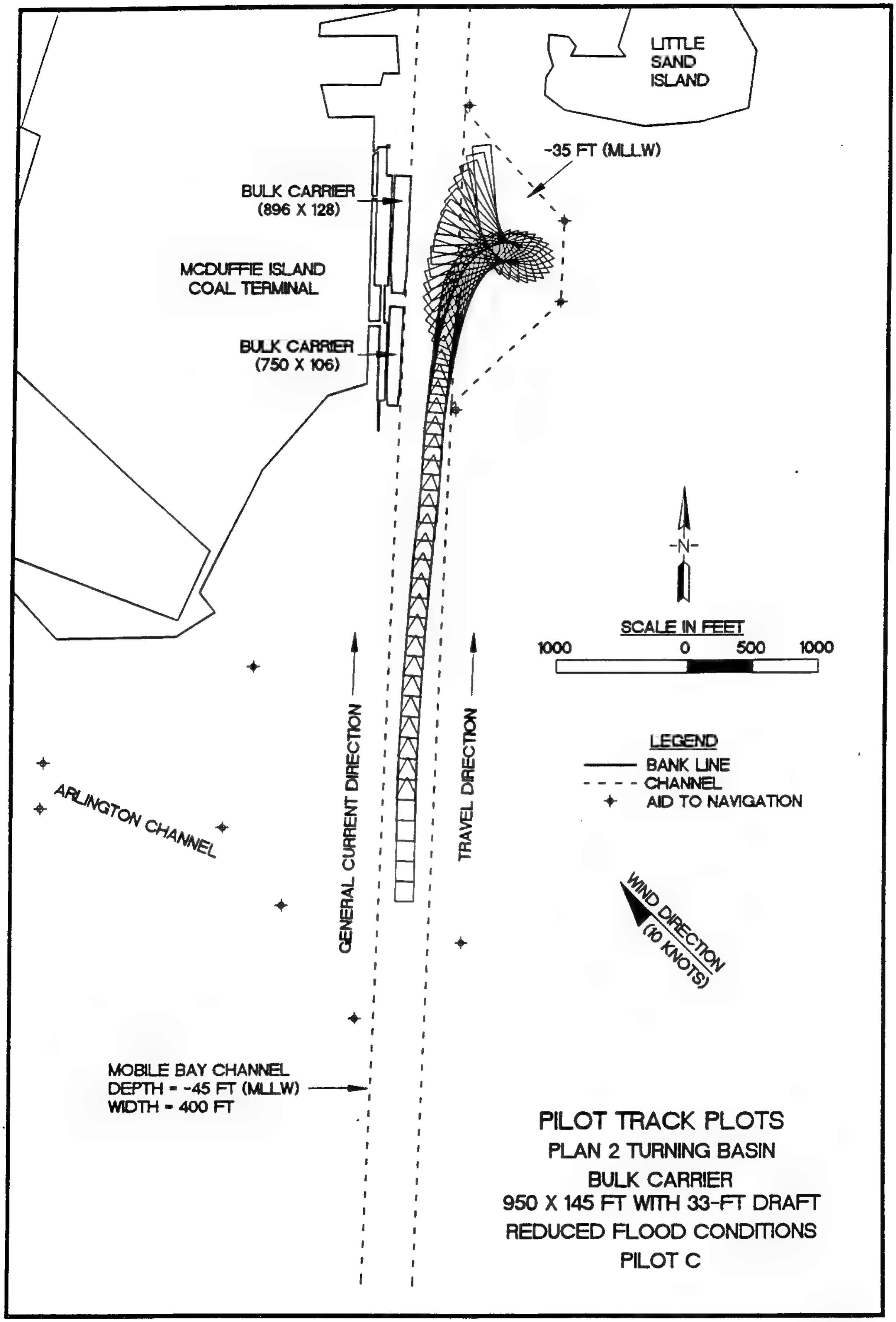
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT F



PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT F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SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT C

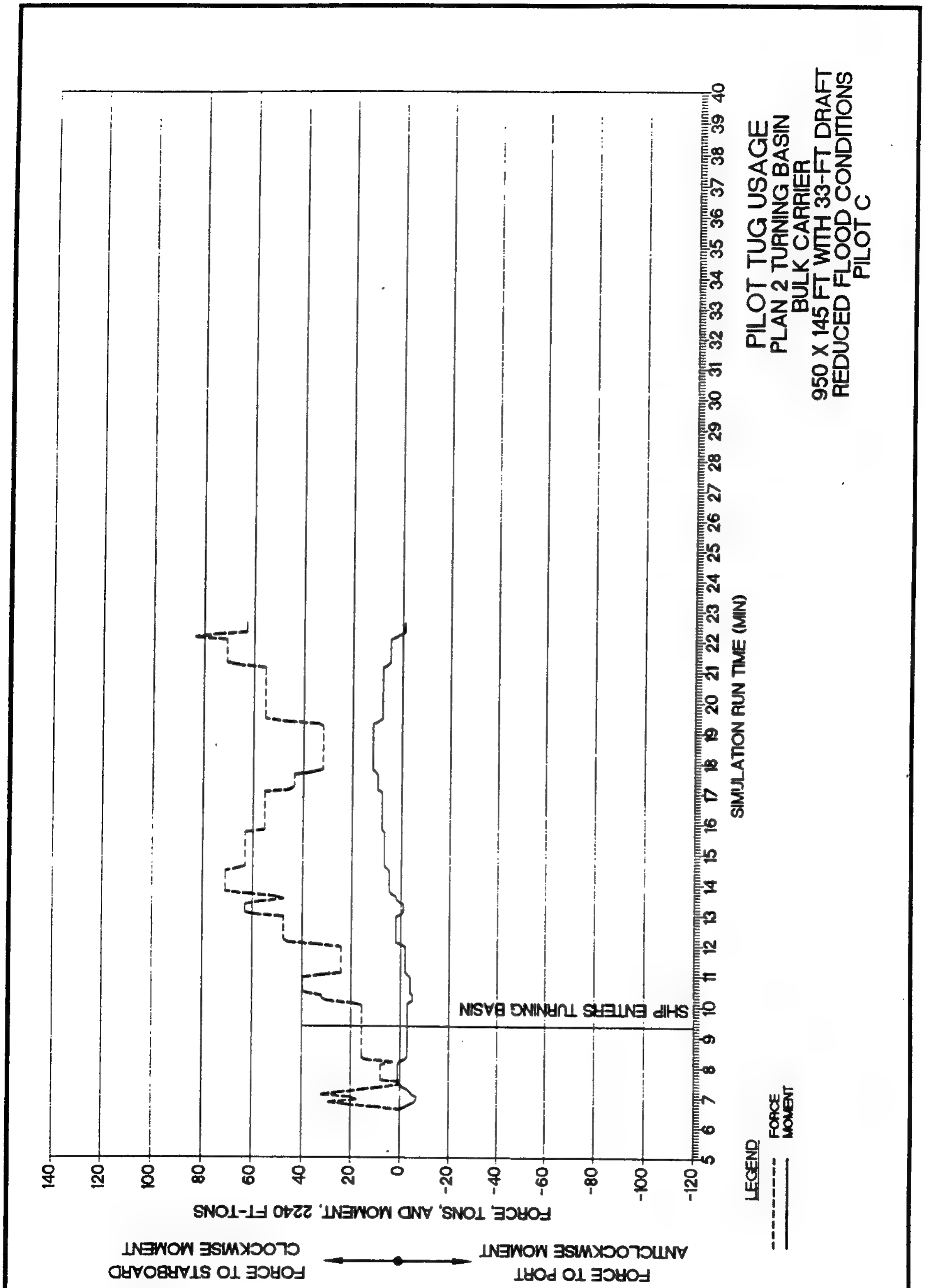
PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT C
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE TO STARBOARD
CLOCKWISE MOMENT
FORCE TO PORT
ANTICLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
FORCE
MOMENT
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
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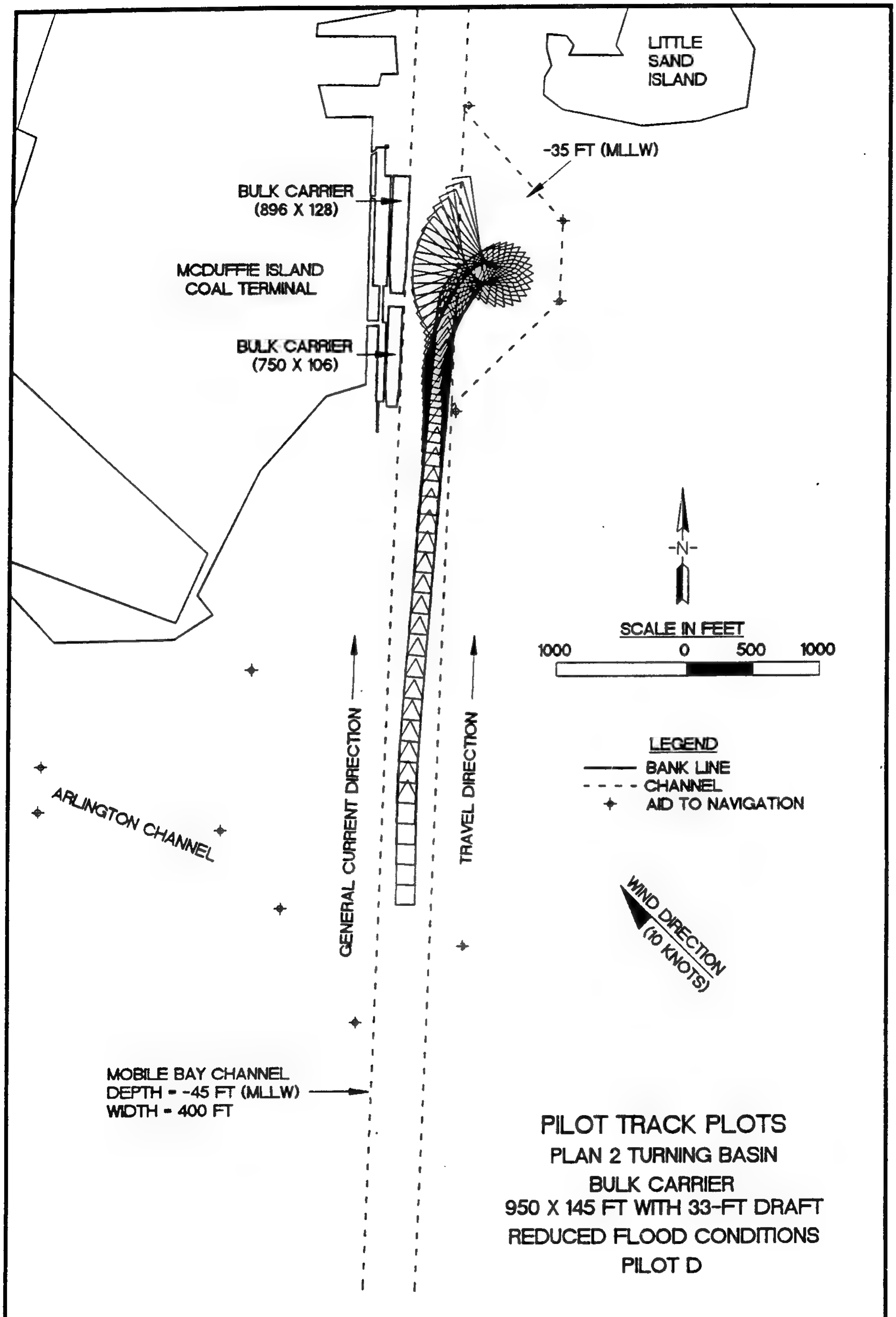
Plate 76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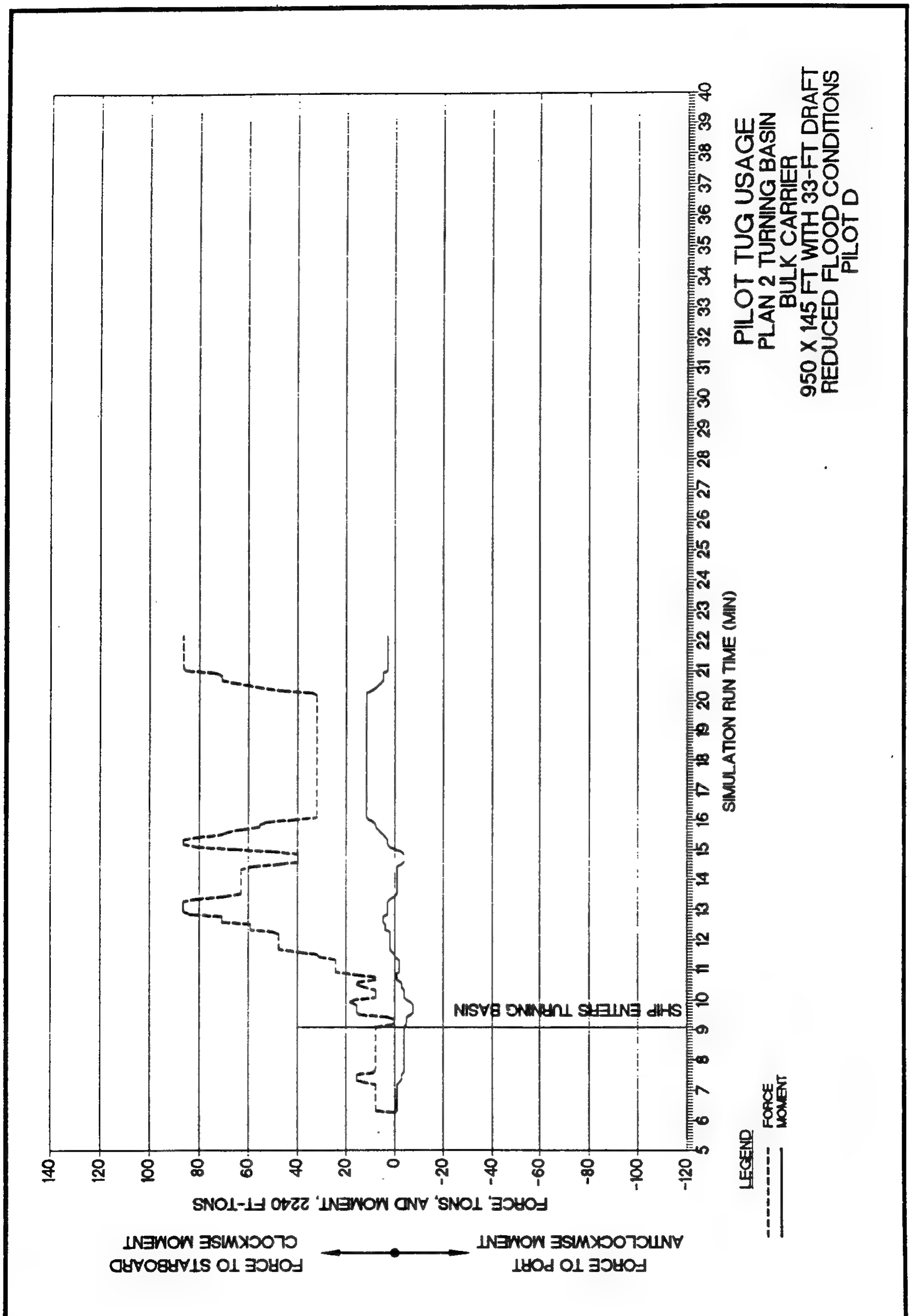
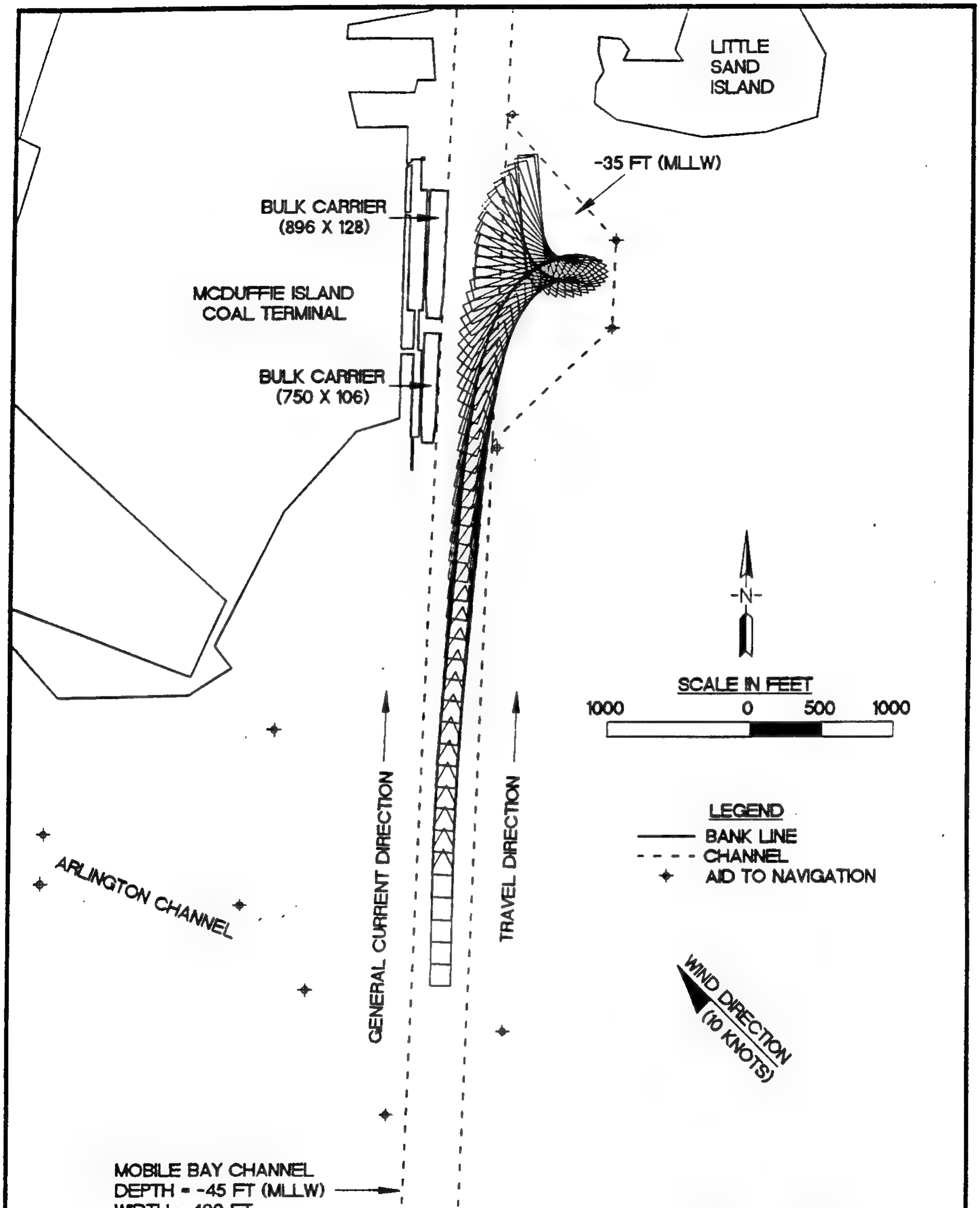
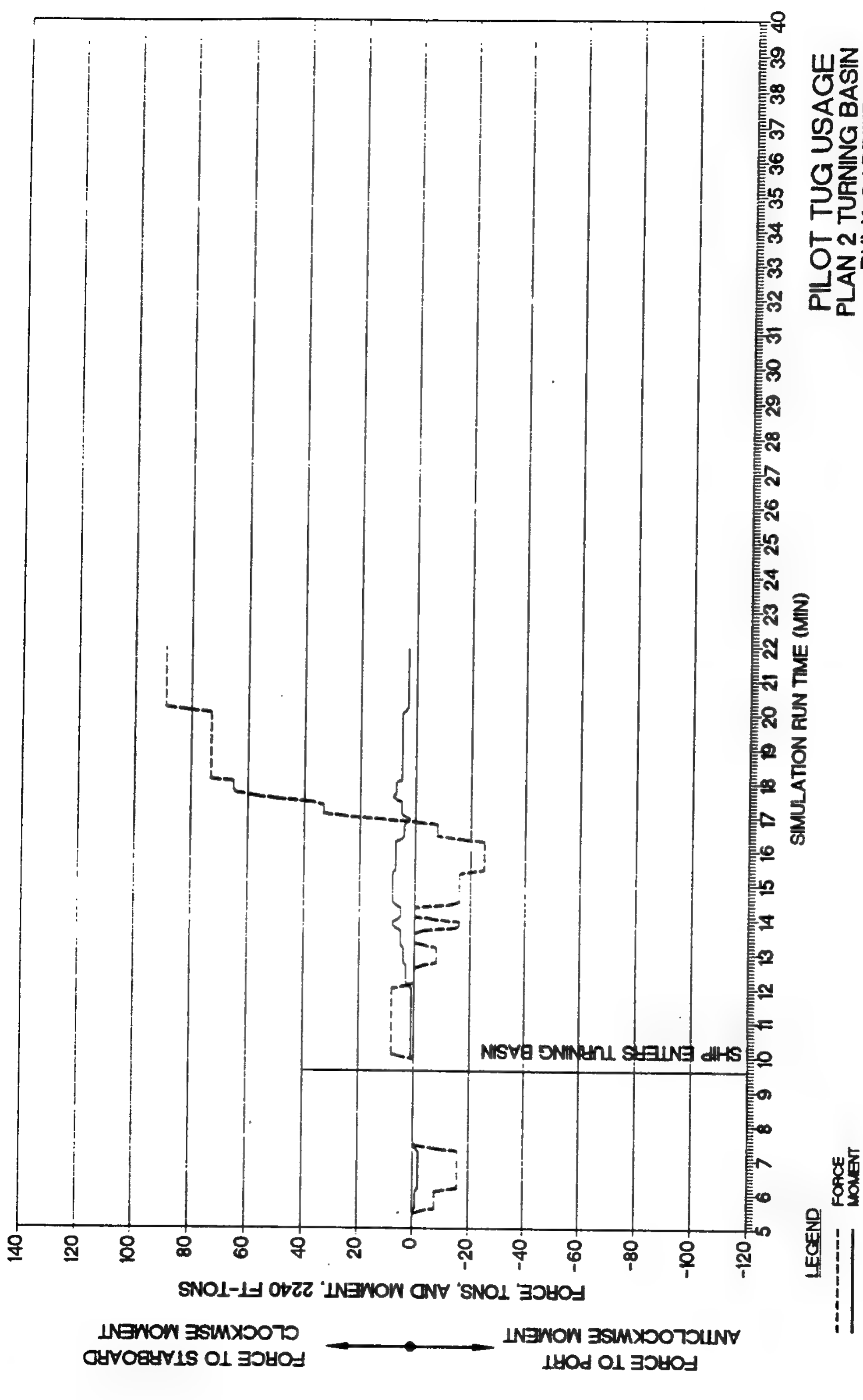
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
SCALE IN FEET
1000
0
500
1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT D



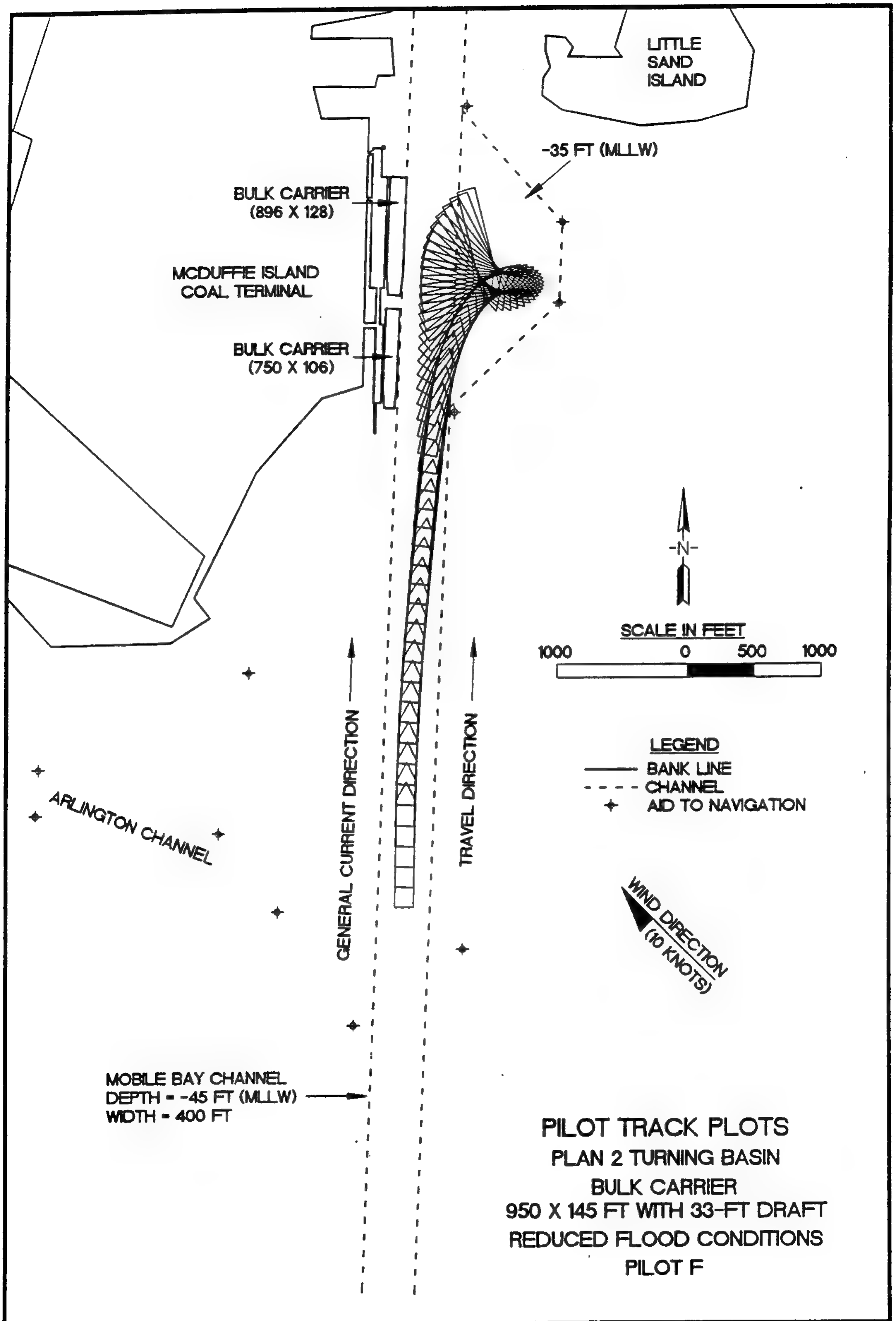
PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT D
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
FORCE
MOMENT

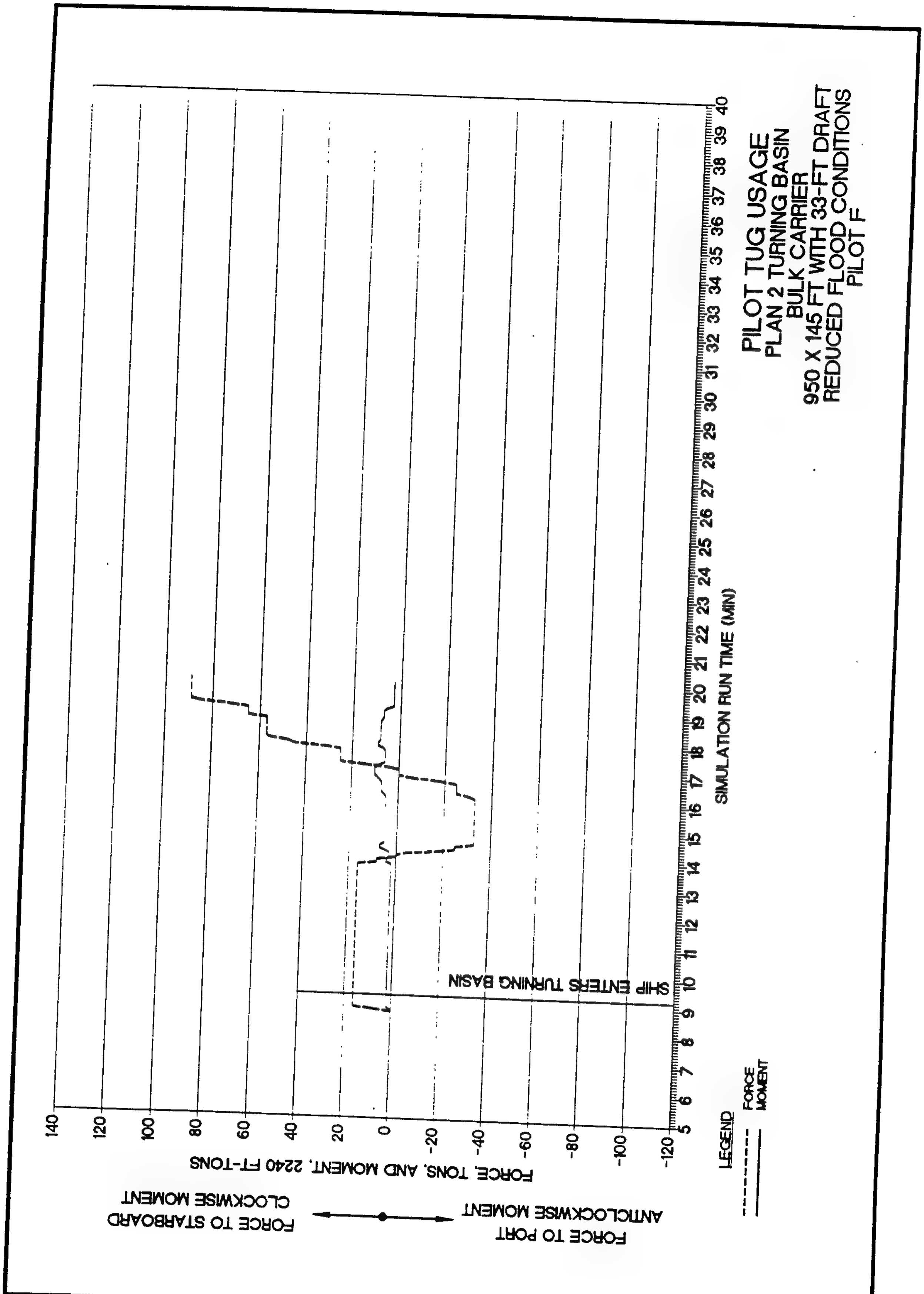


PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT E

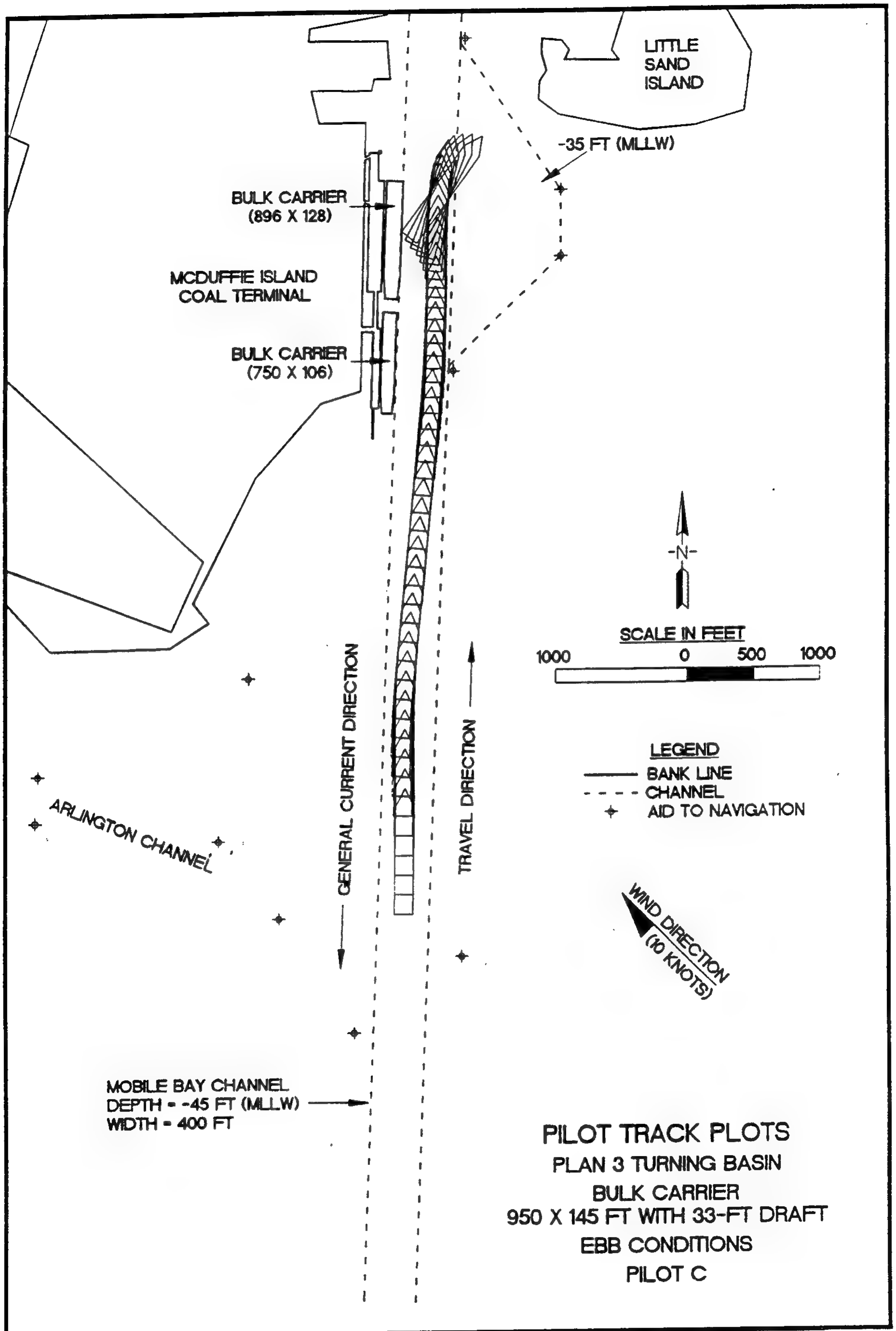


PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT E

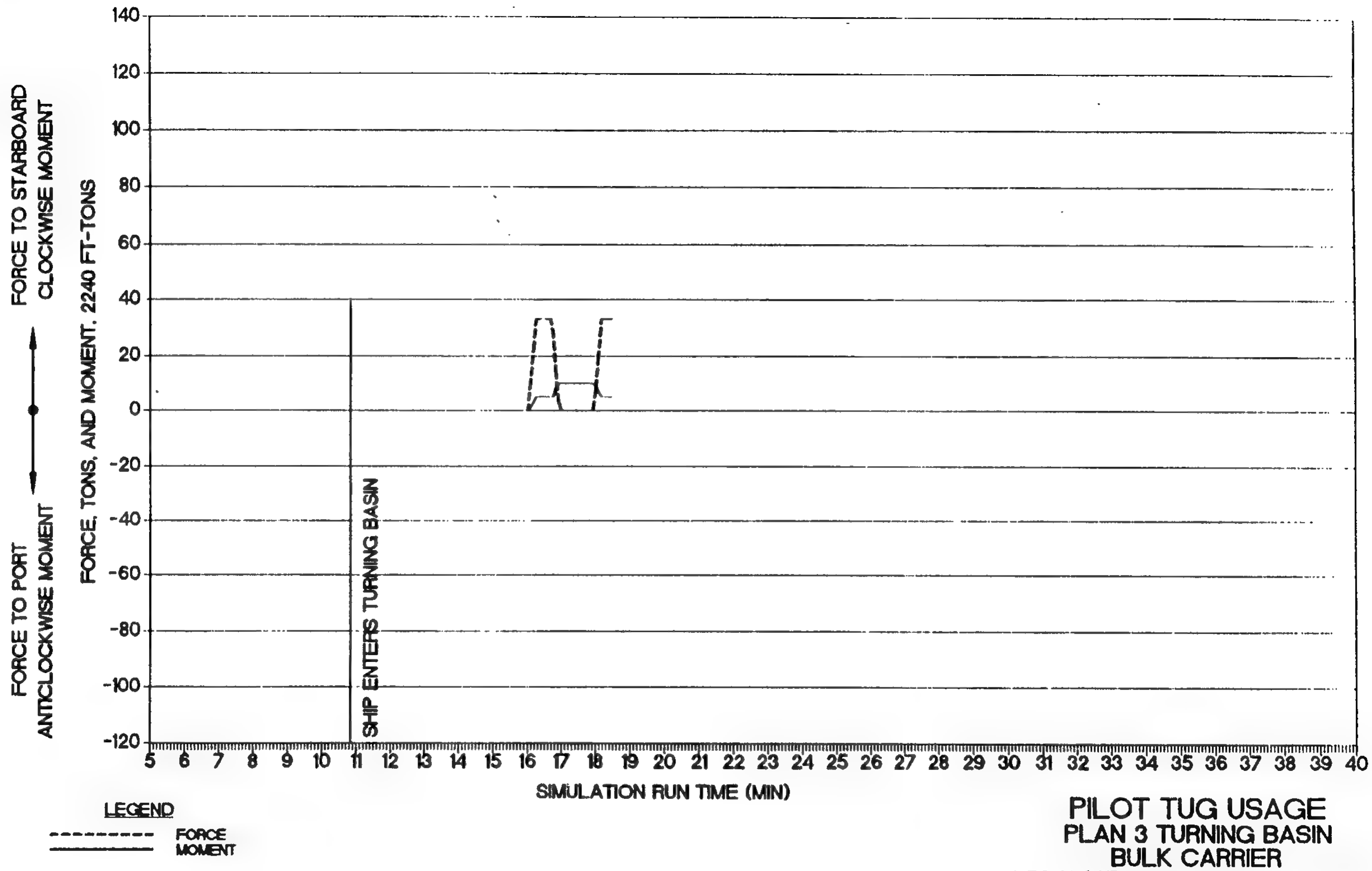

LITTLE
SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000
0
500
1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT F


PILOT TUG USAGE
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT F
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
FORCE
MOMENT

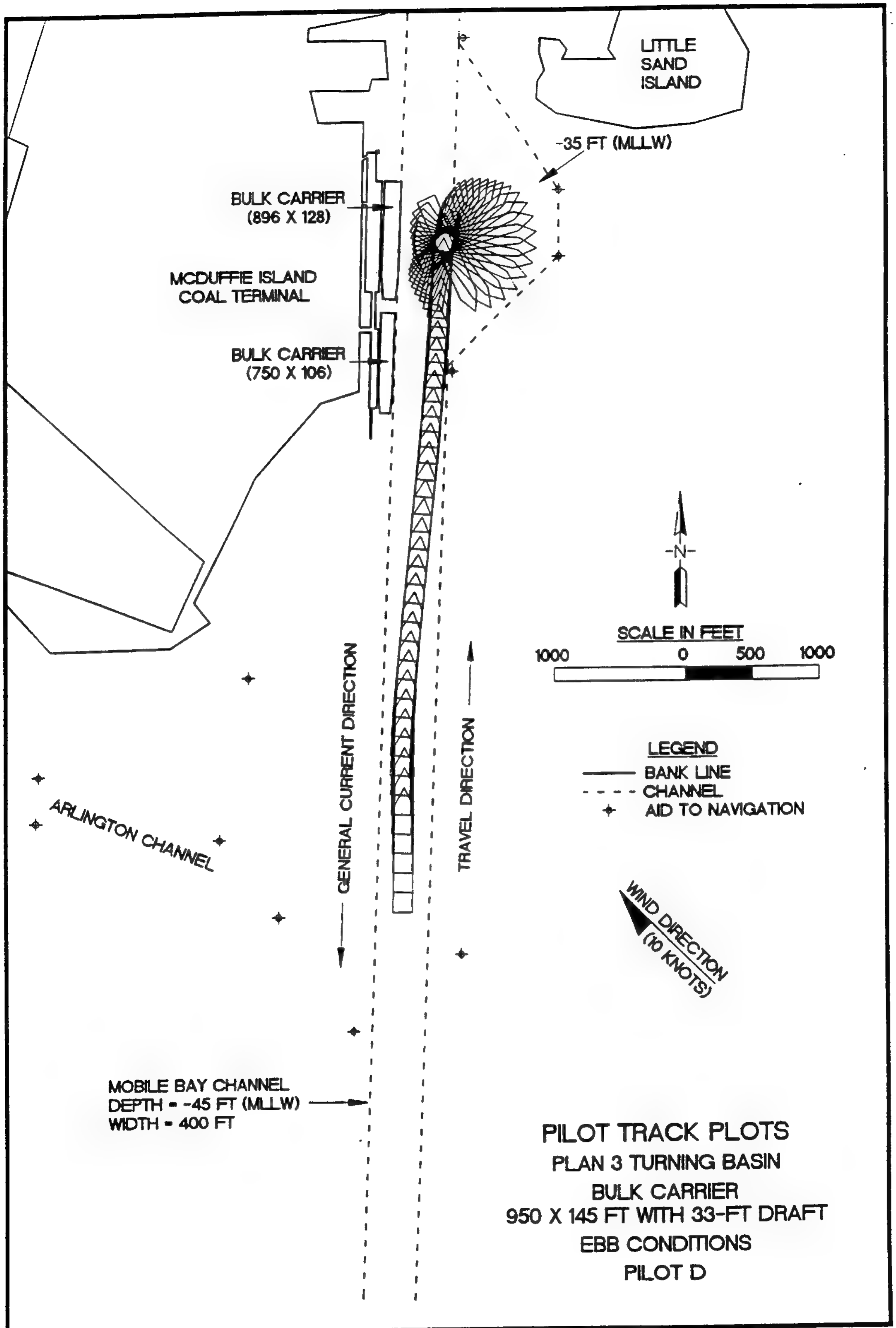
Plan 3 Results



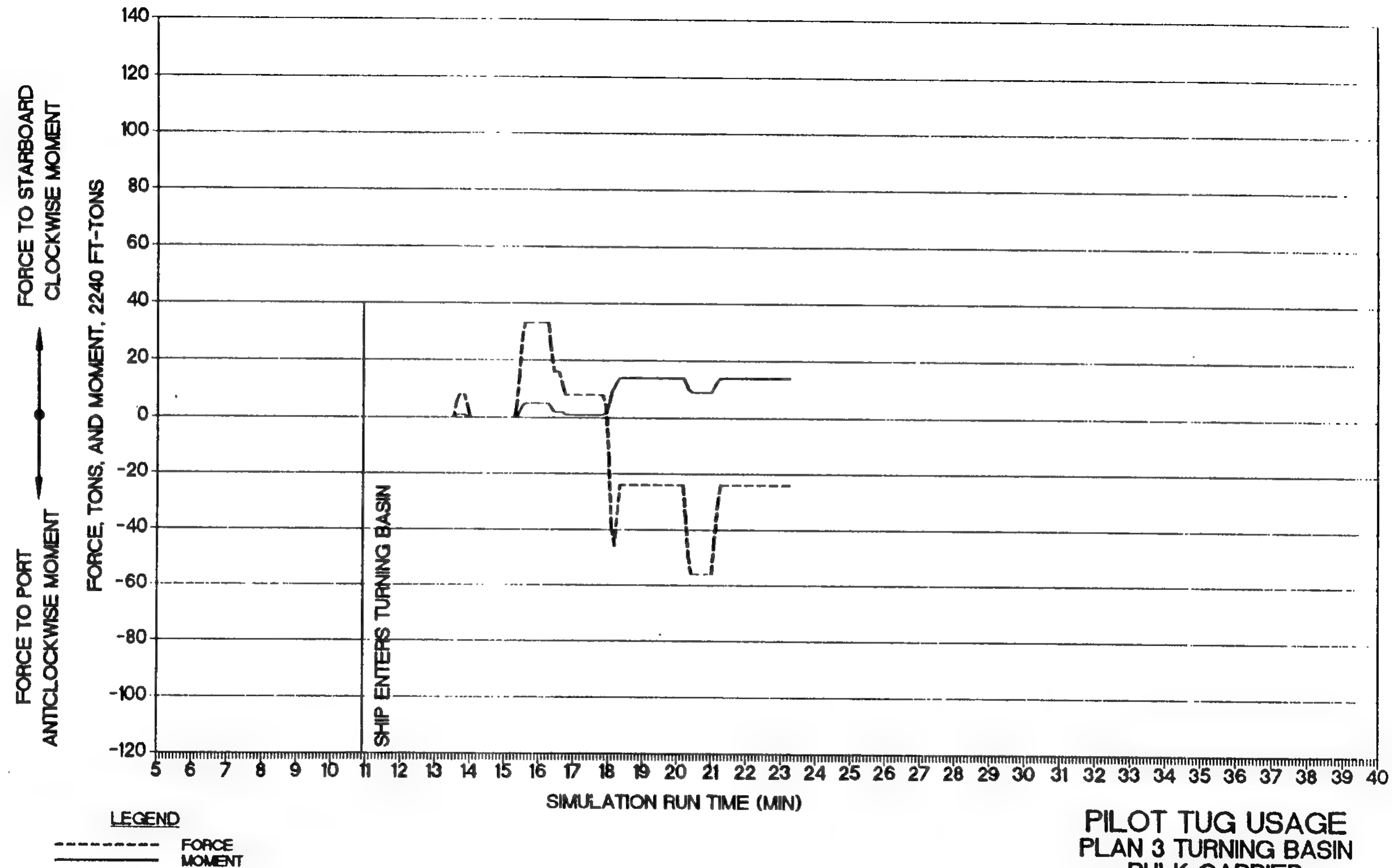
LITTLE
SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
EBB CONDITIONS
PILOT C



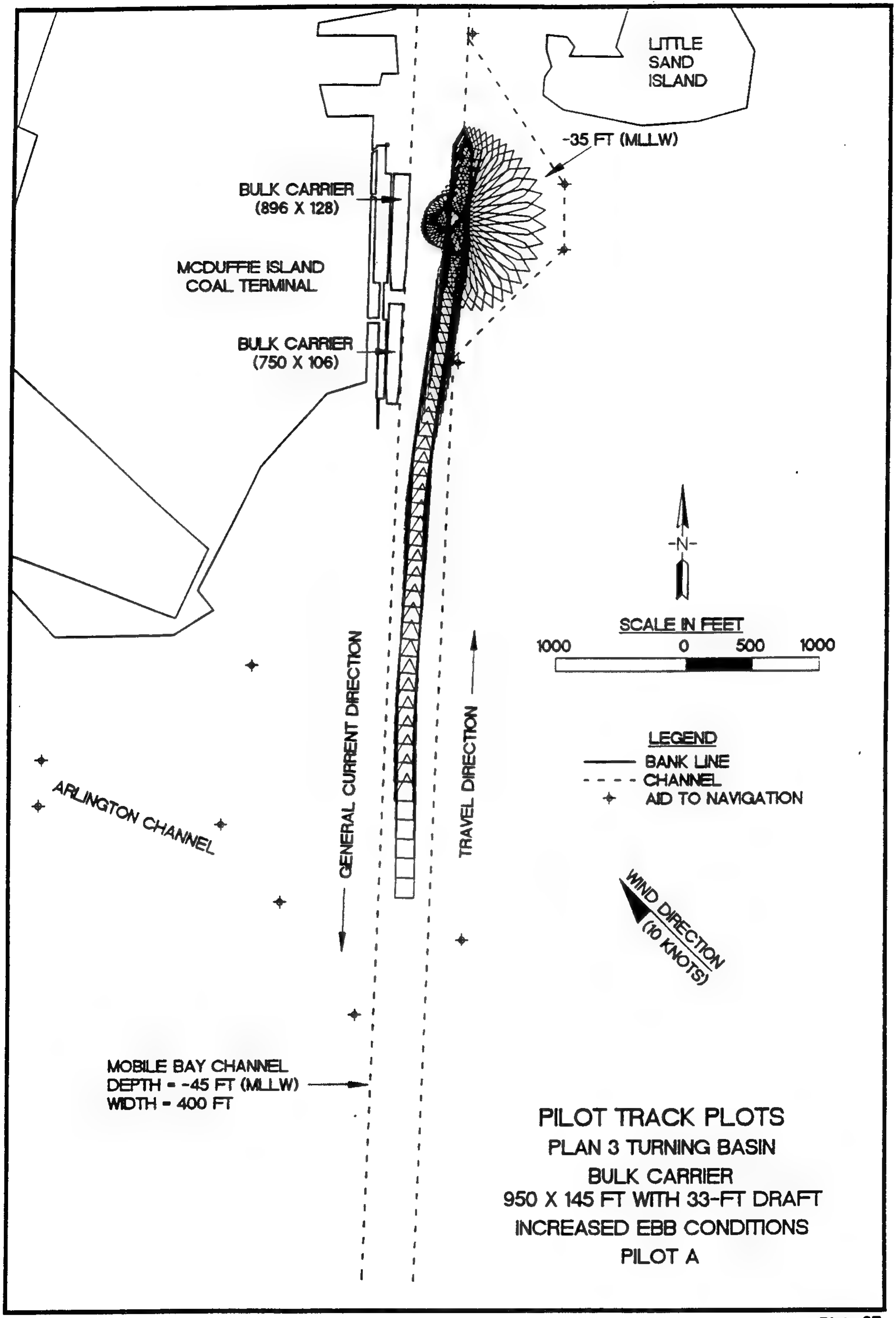
PILOT TUG USAGE
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
EBB CONDITIONS
PILOT C

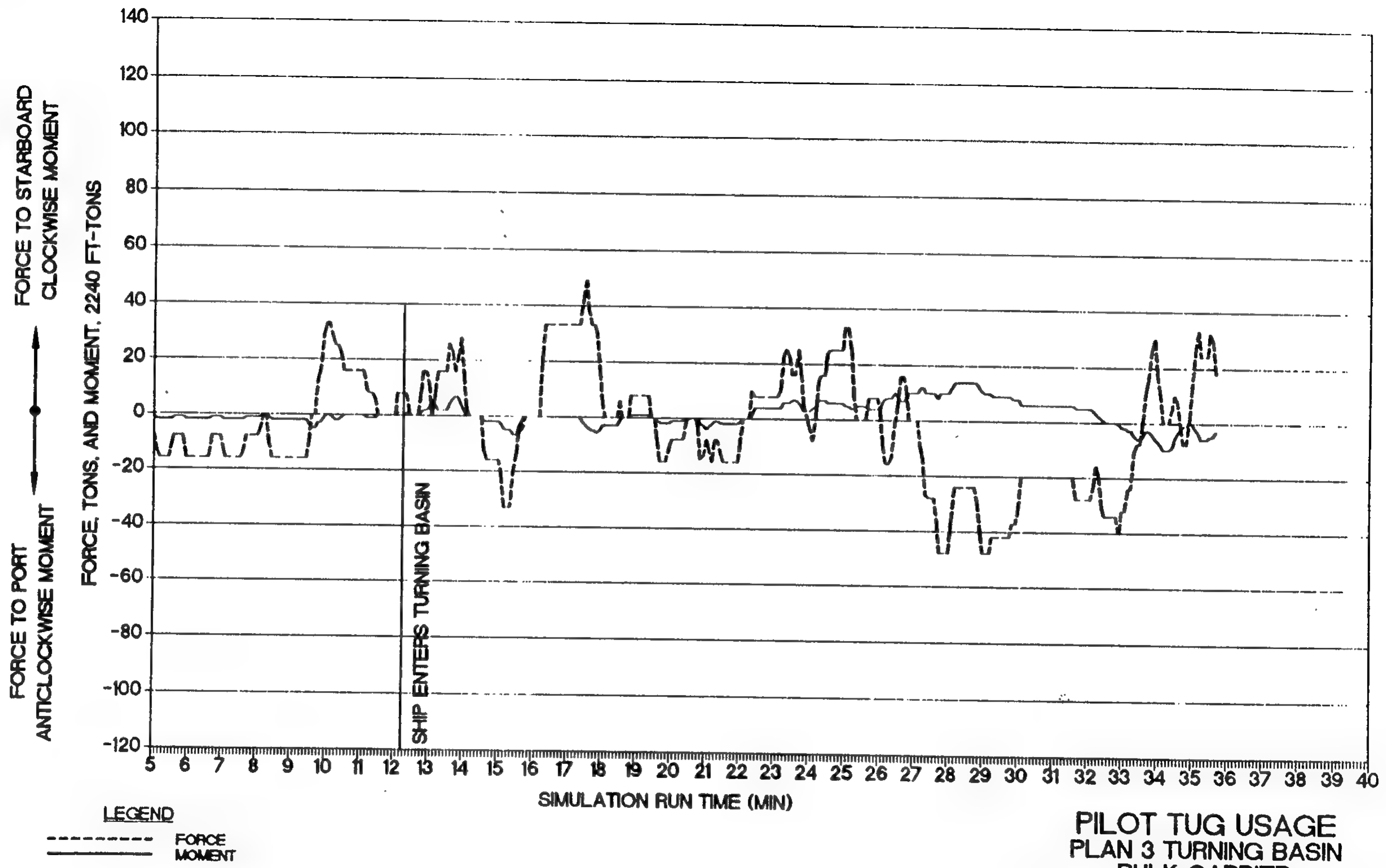


LITTLE
SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
SCALE IN FEET
1000
0
500
1000
N
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
EBB CONDITIONS
PILOT D

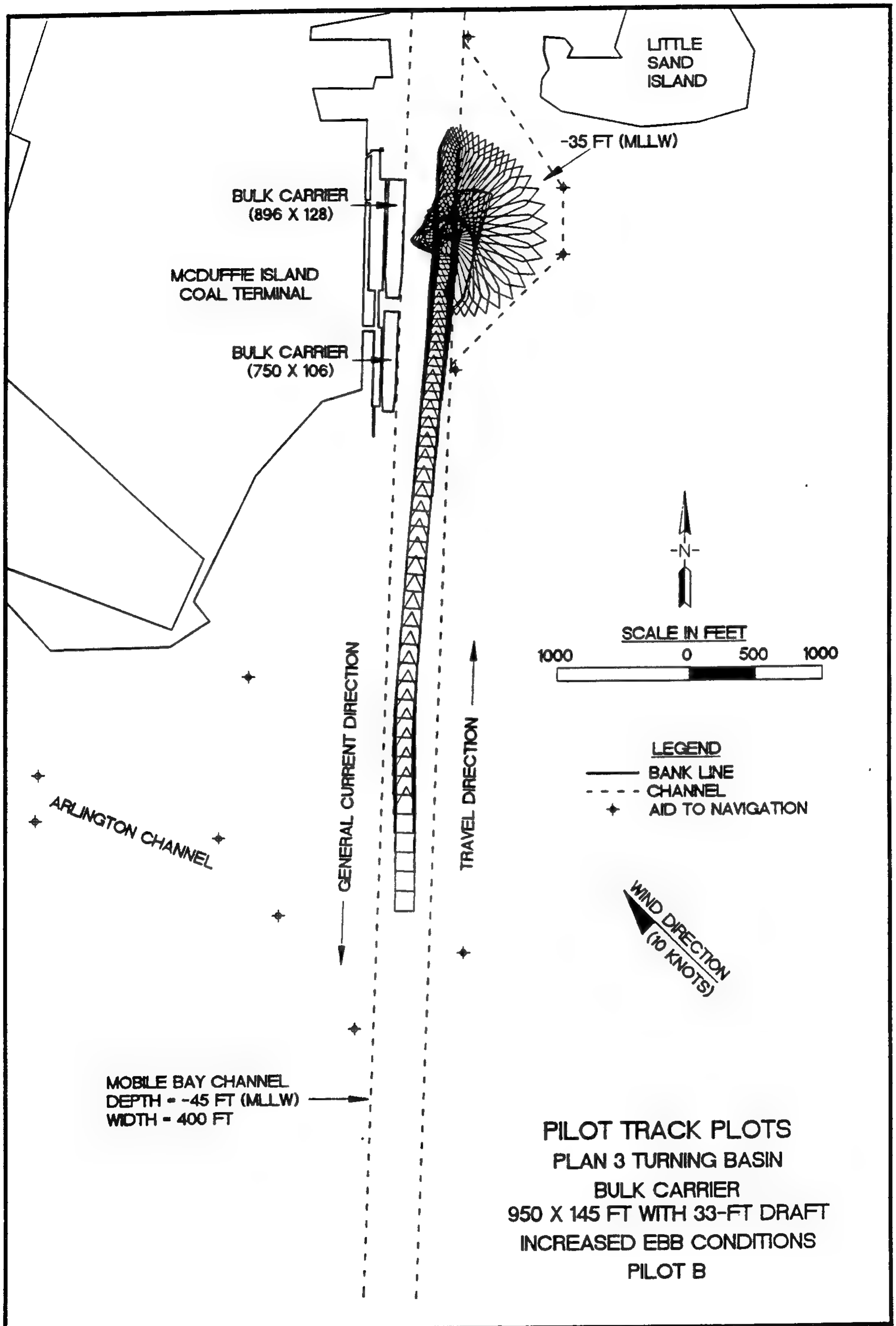


PILOT TUG USAGE
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
EBB CONDITIONS
PILOT D

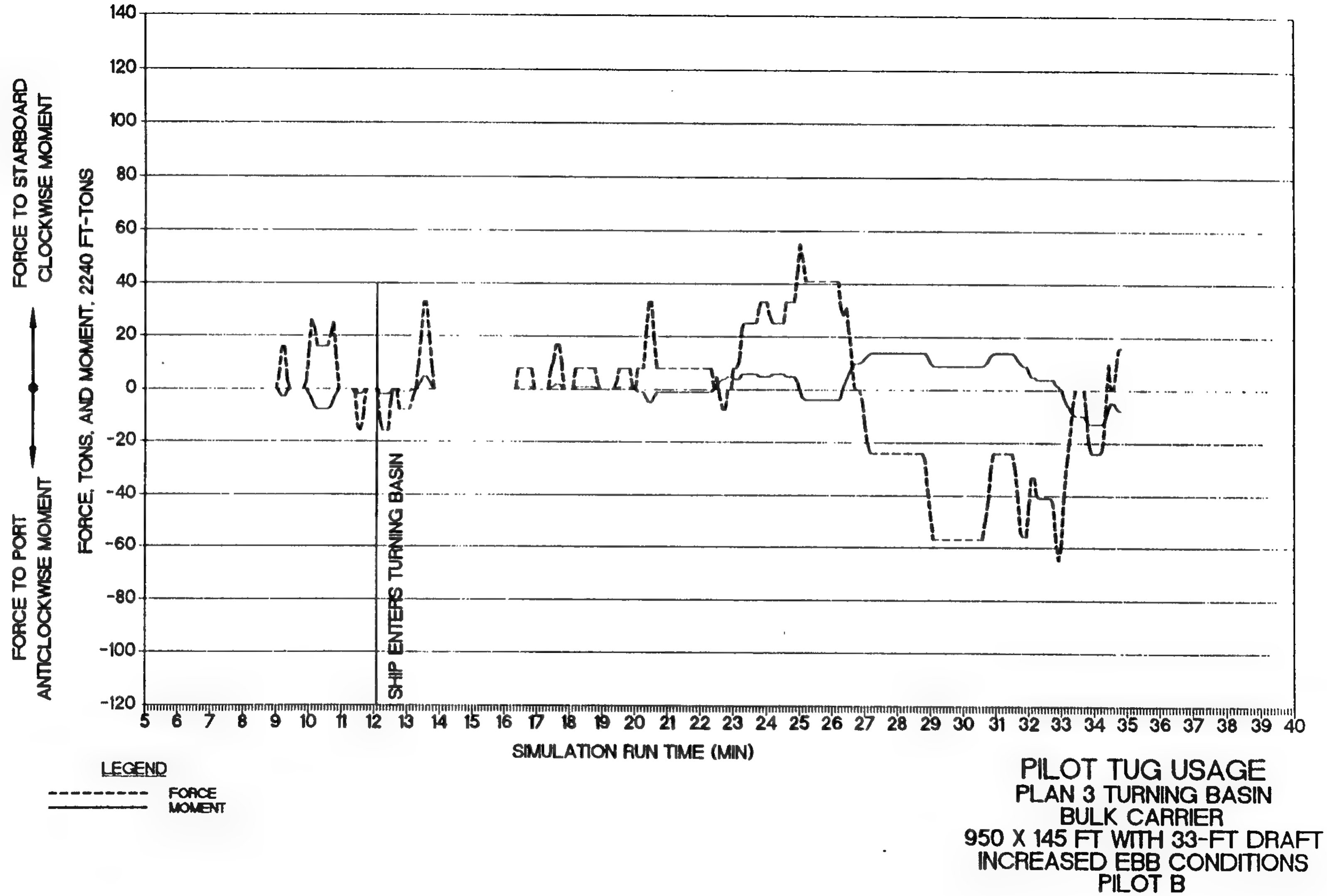

LITTLE SAND ISLAND
-35 FT (MLLW)
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT A

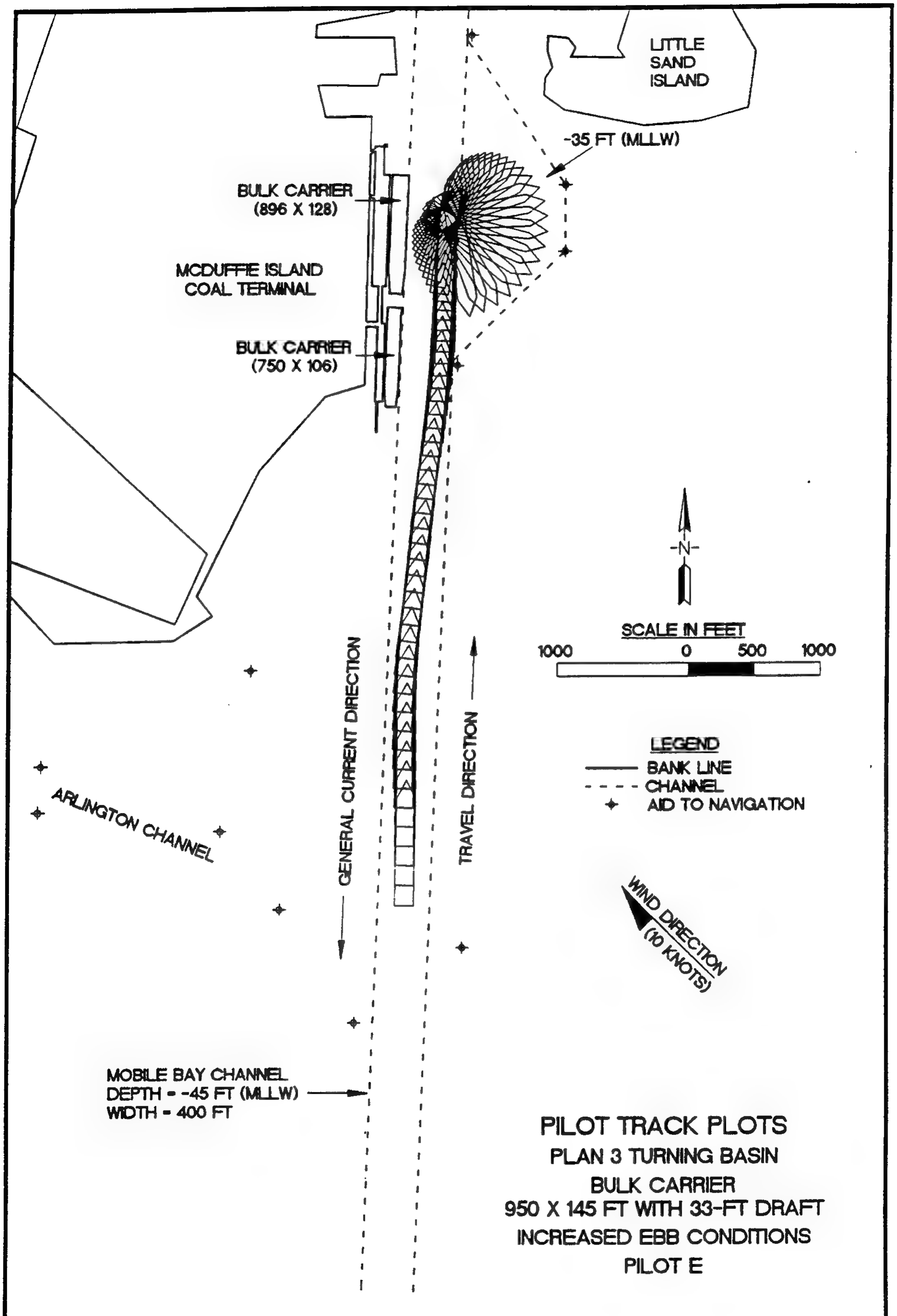


PILOT TUG USAGE
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT A

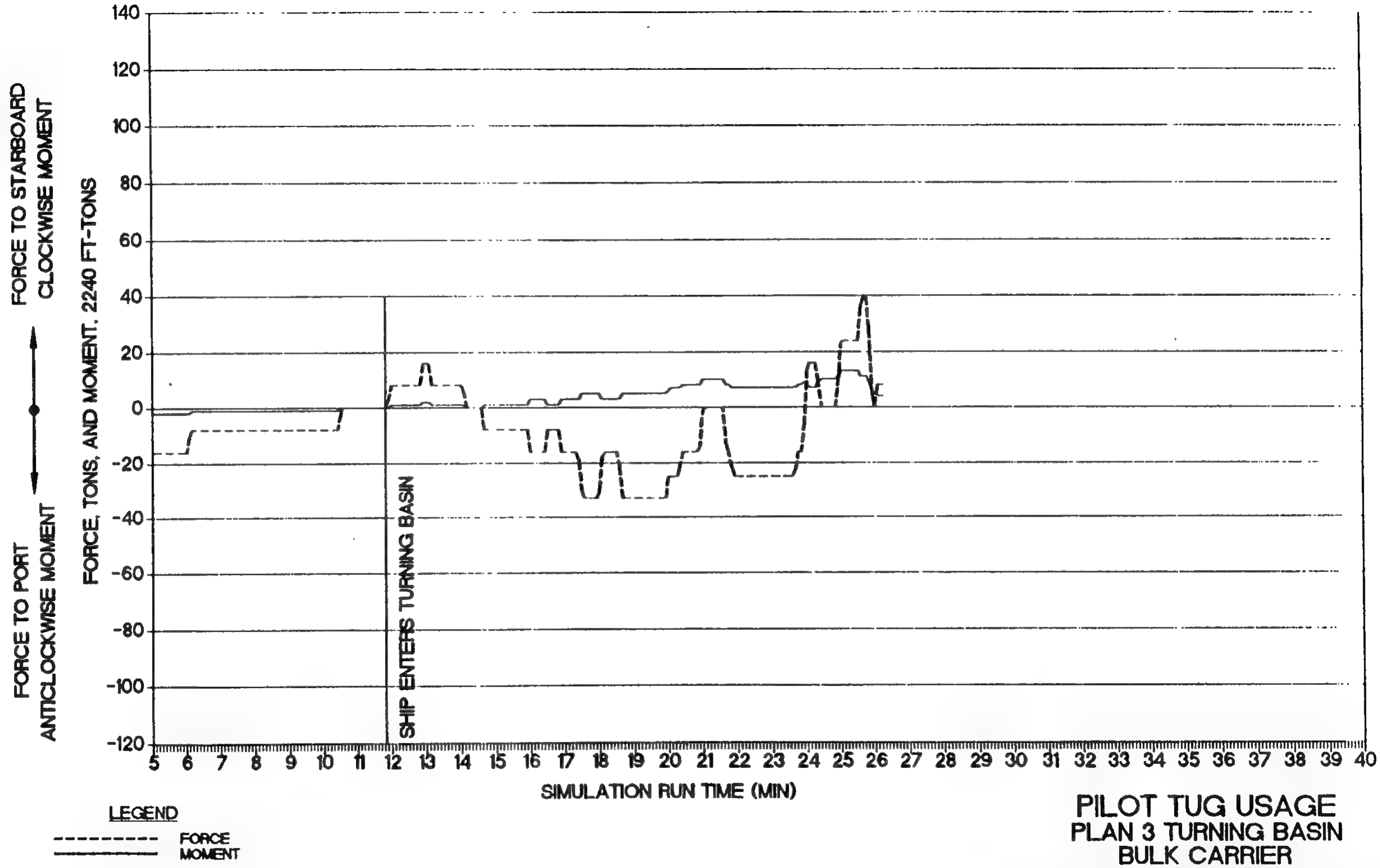


PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT B

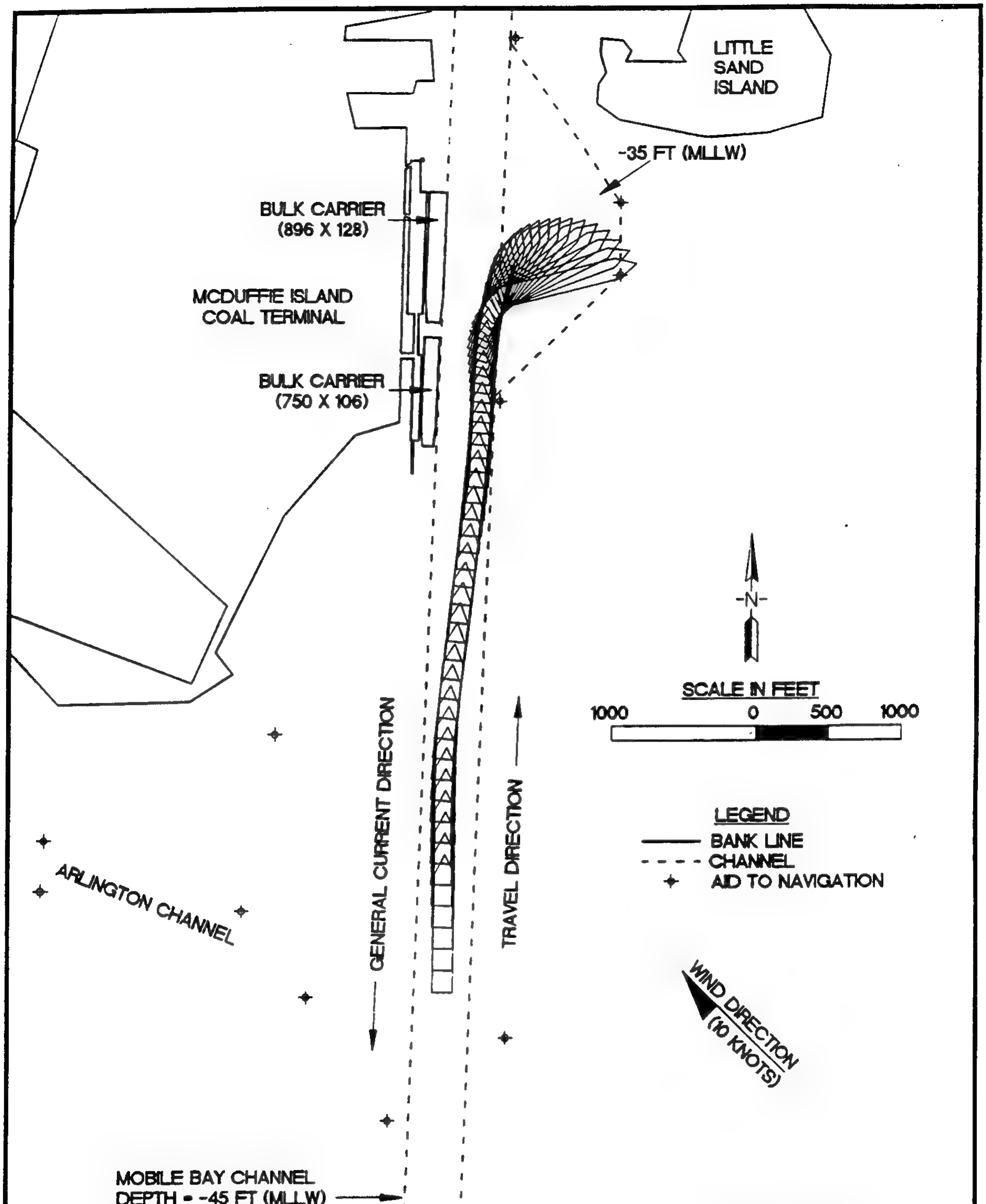

FORCE TO STARBOARD
CLOCKWISE MOMENT
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE, TONS, AND MOMENT, 2240 FT-TONS
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
SIMULATION RUN TIME (MIN)
SHIP ENTERS TURNING BASIN
LEGEND
FORCE
MOMENT
PILOT TUG USAGE
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT B



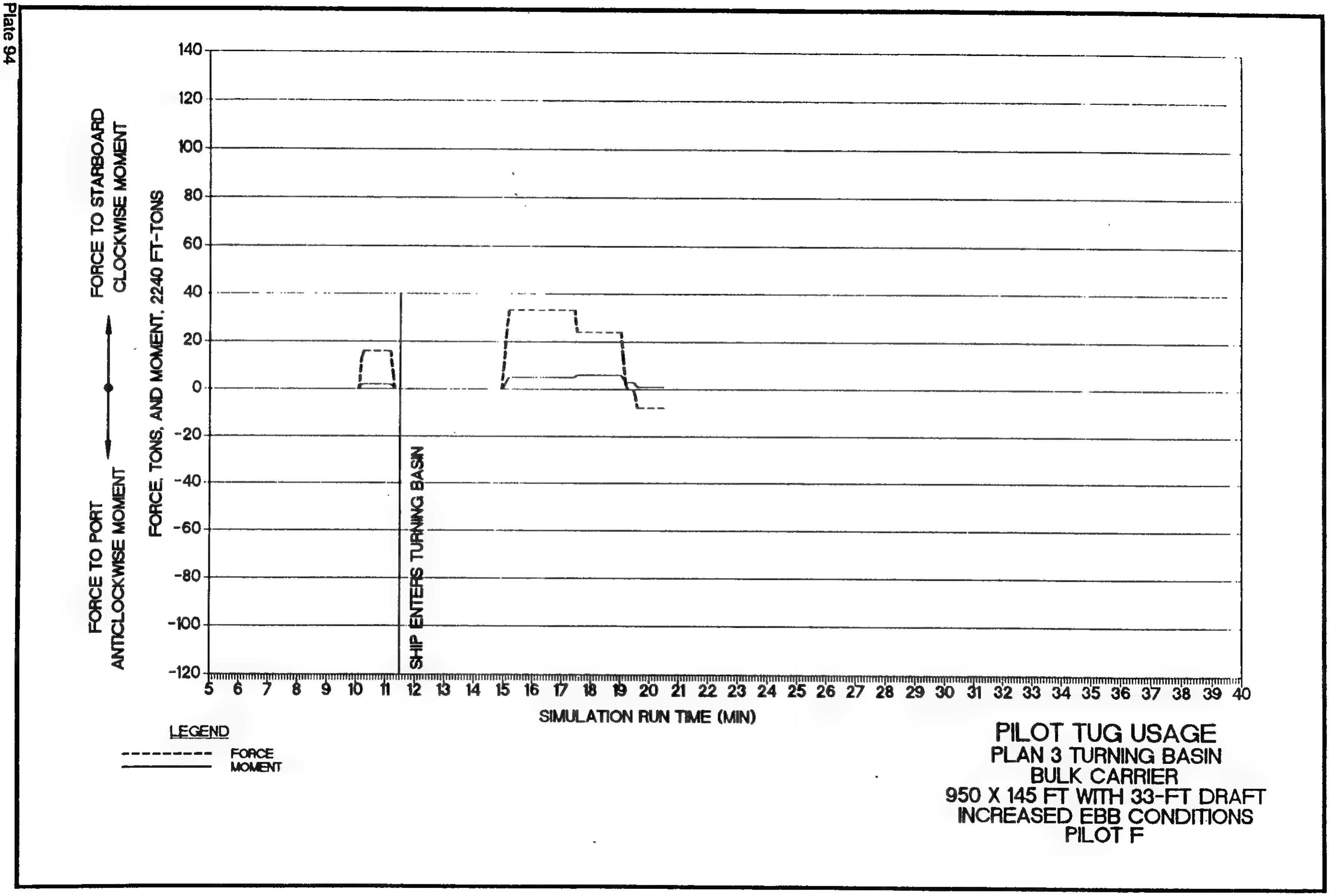
LITTLE
SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT E

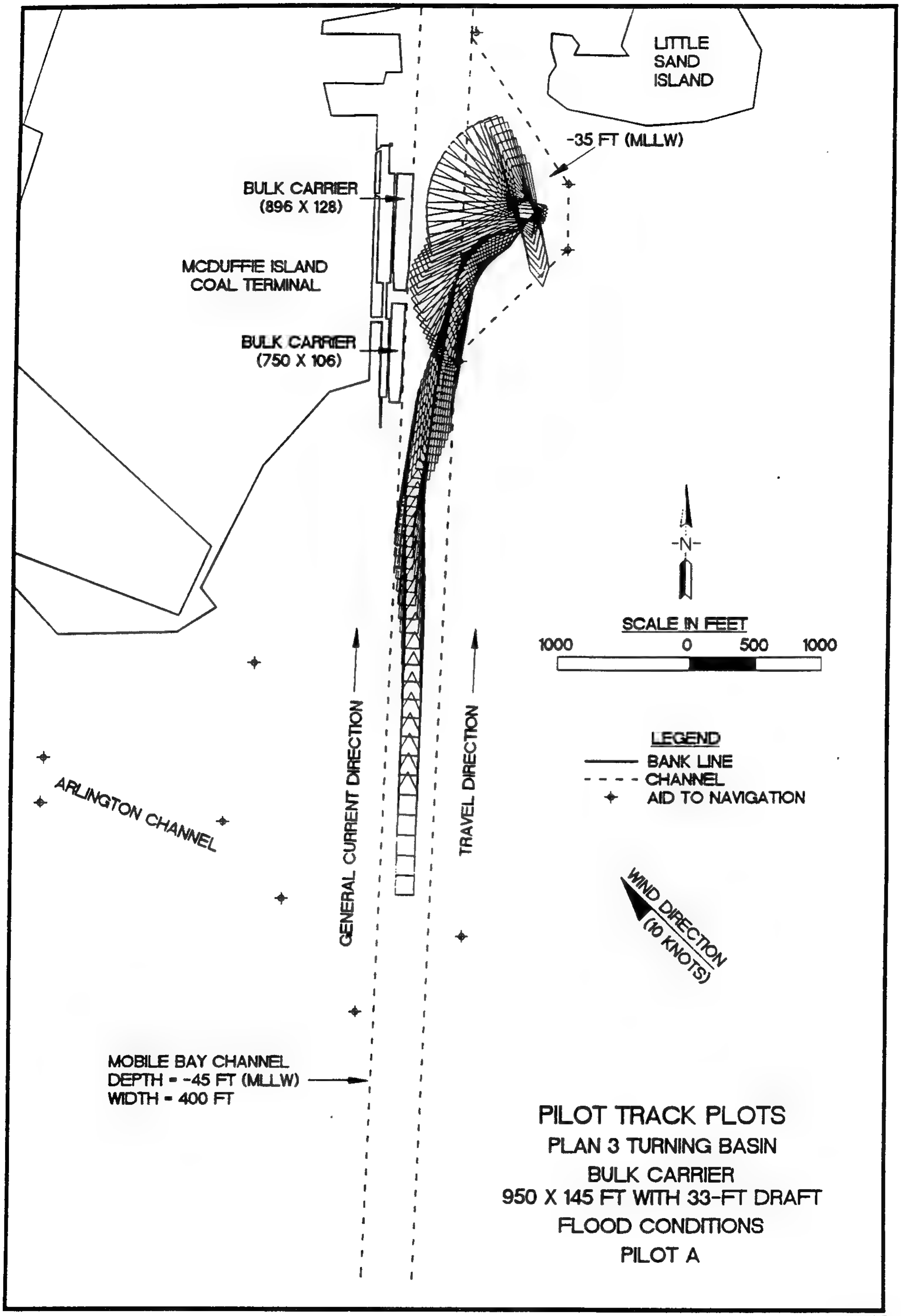


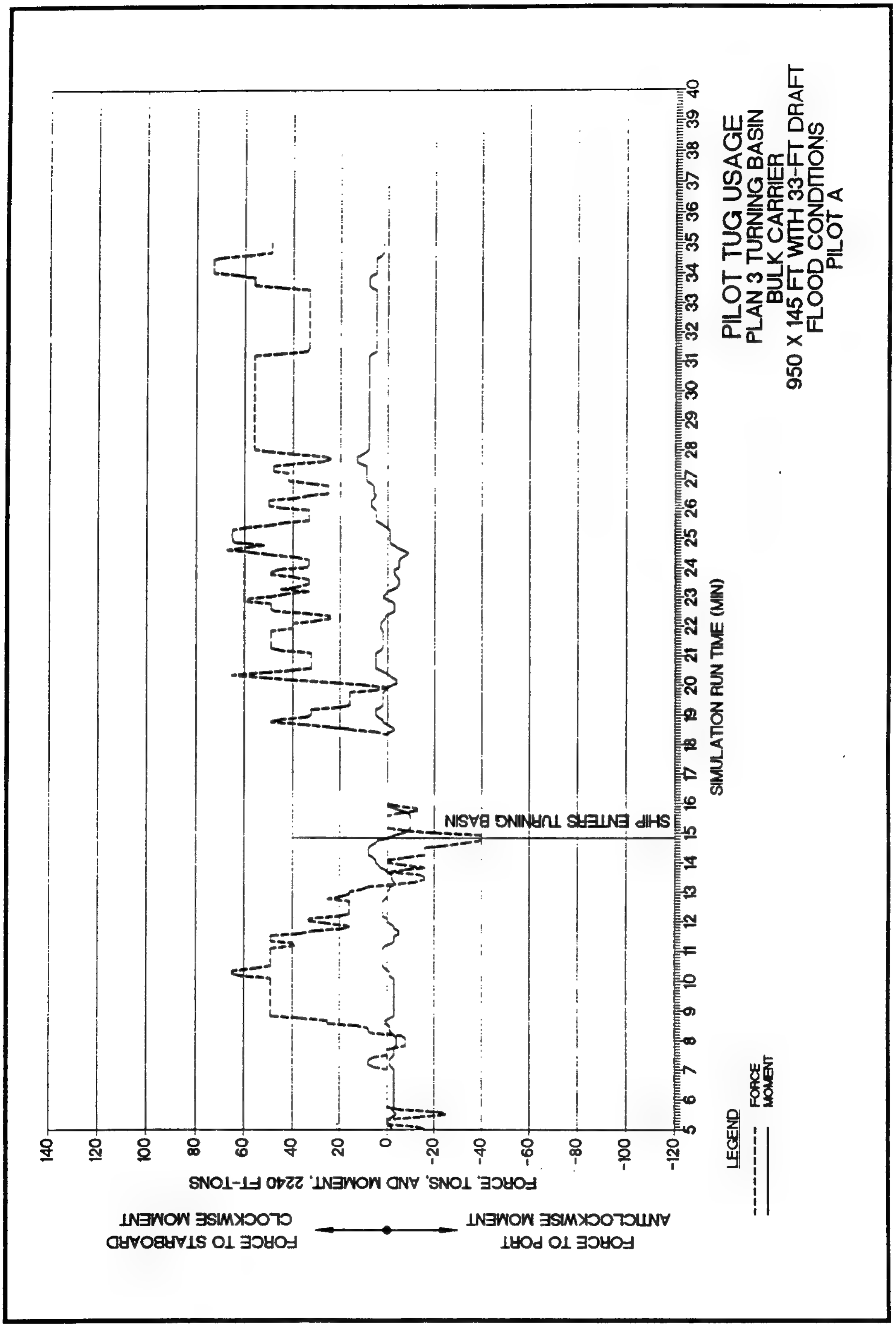
PILOT TUG USAGE
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT E



PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT F


FORCE TO STARBOARD
CLOCKWISE MOMENT
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE, TONS, AND MOMENT, 2240 FT-TONS
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
SIMULATION RUN TIME (MIN)
SHIP ENTERS TURNING BASIN
LEGEND
FORCE
MOMENT
PILOT TUG USAGE
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT F


LITTLE
SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
SCALE IN FEET
1000 0 500 1000
-N-
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT A


PILOT TUG USAGE
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT A
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
SHIP ENTERS TURNING BASIN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
LEGEND
FORCE
MOMENT

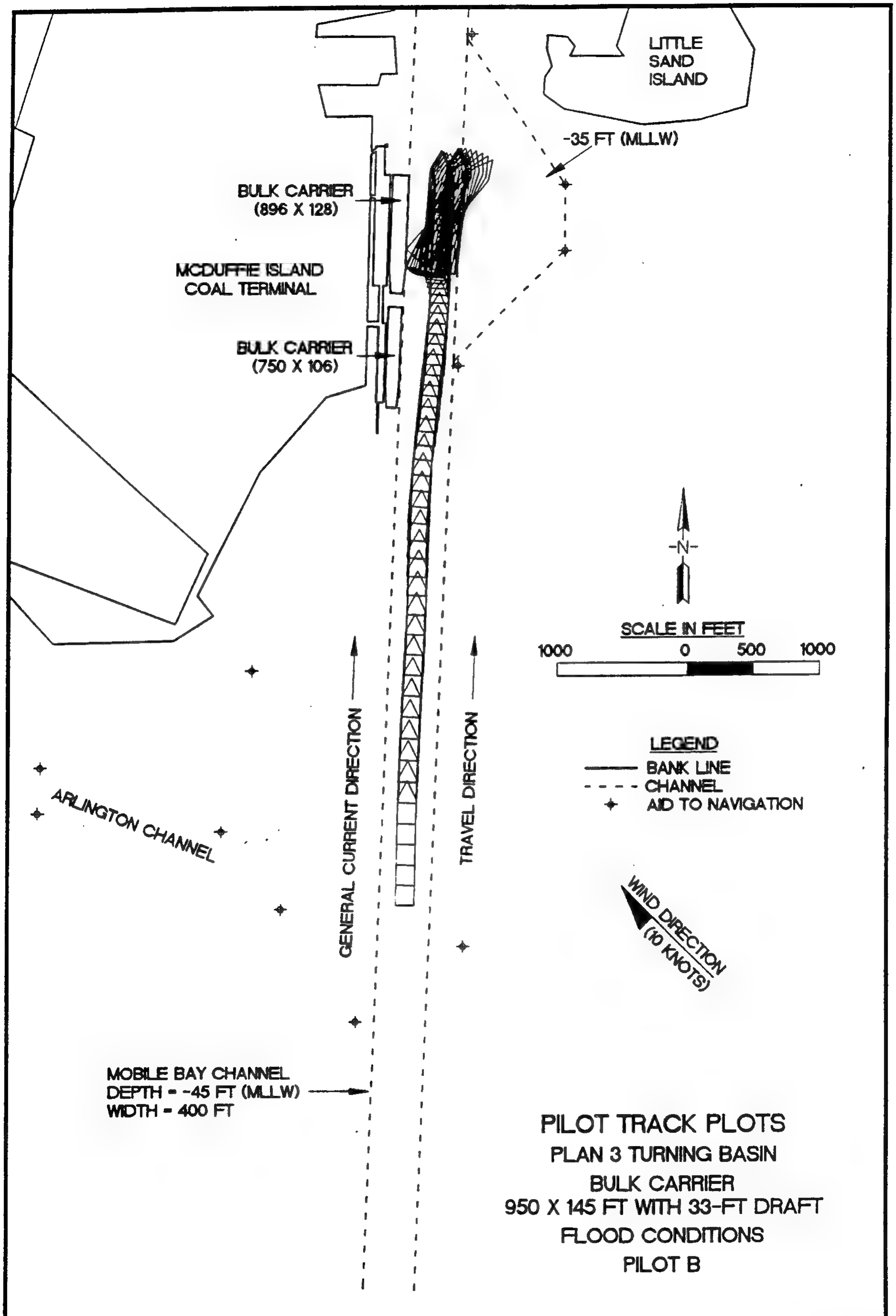
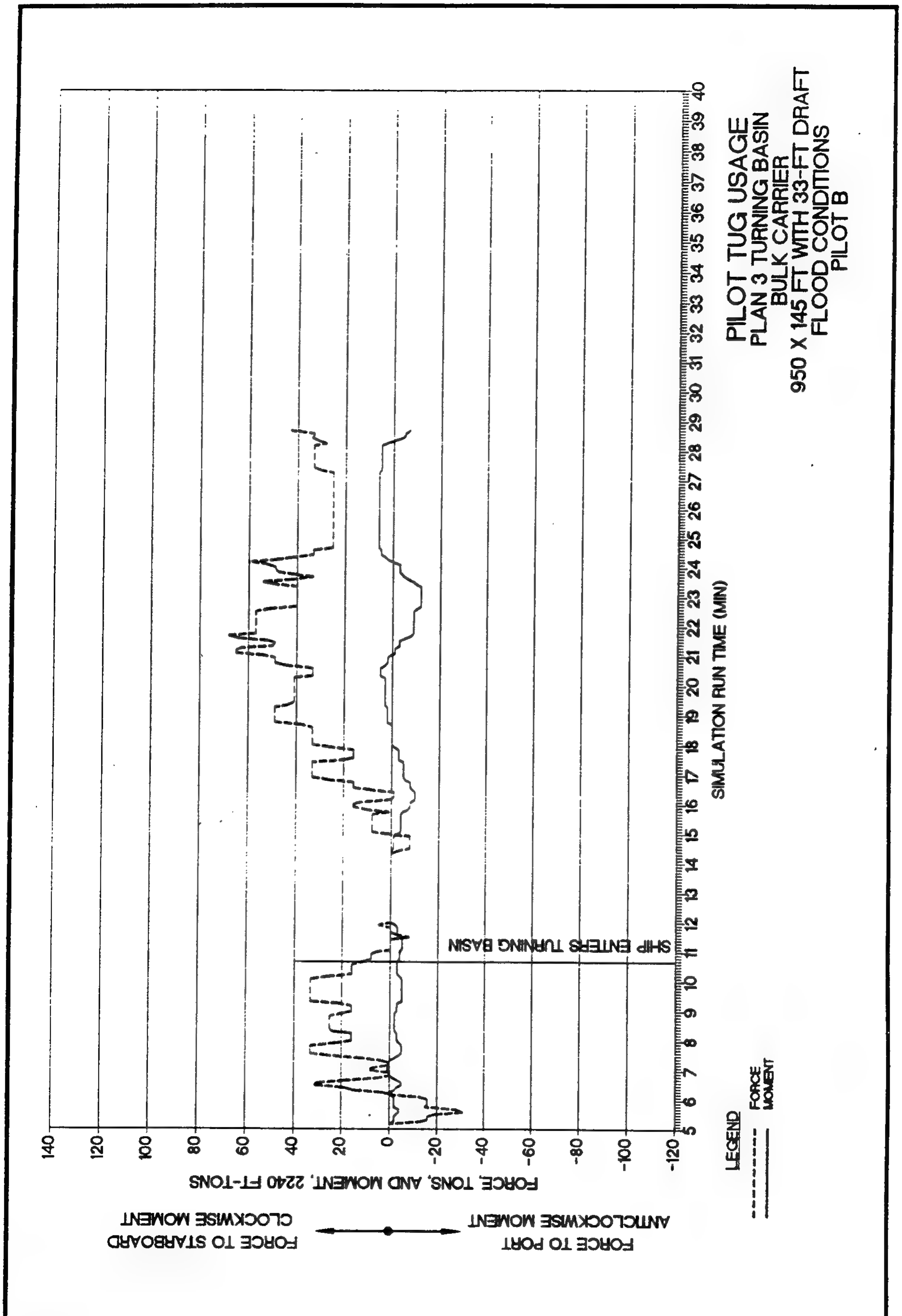

LITTLE
SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT B

Plate 97



PILOT TUG USAGE
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT B
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE TO STARBOARD
CLOCKWISE MOMENT
FORCE TO PORT
ANTICLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
FORCE
MOMENT
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
5
6
7
8
9
10
11
12
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14
15
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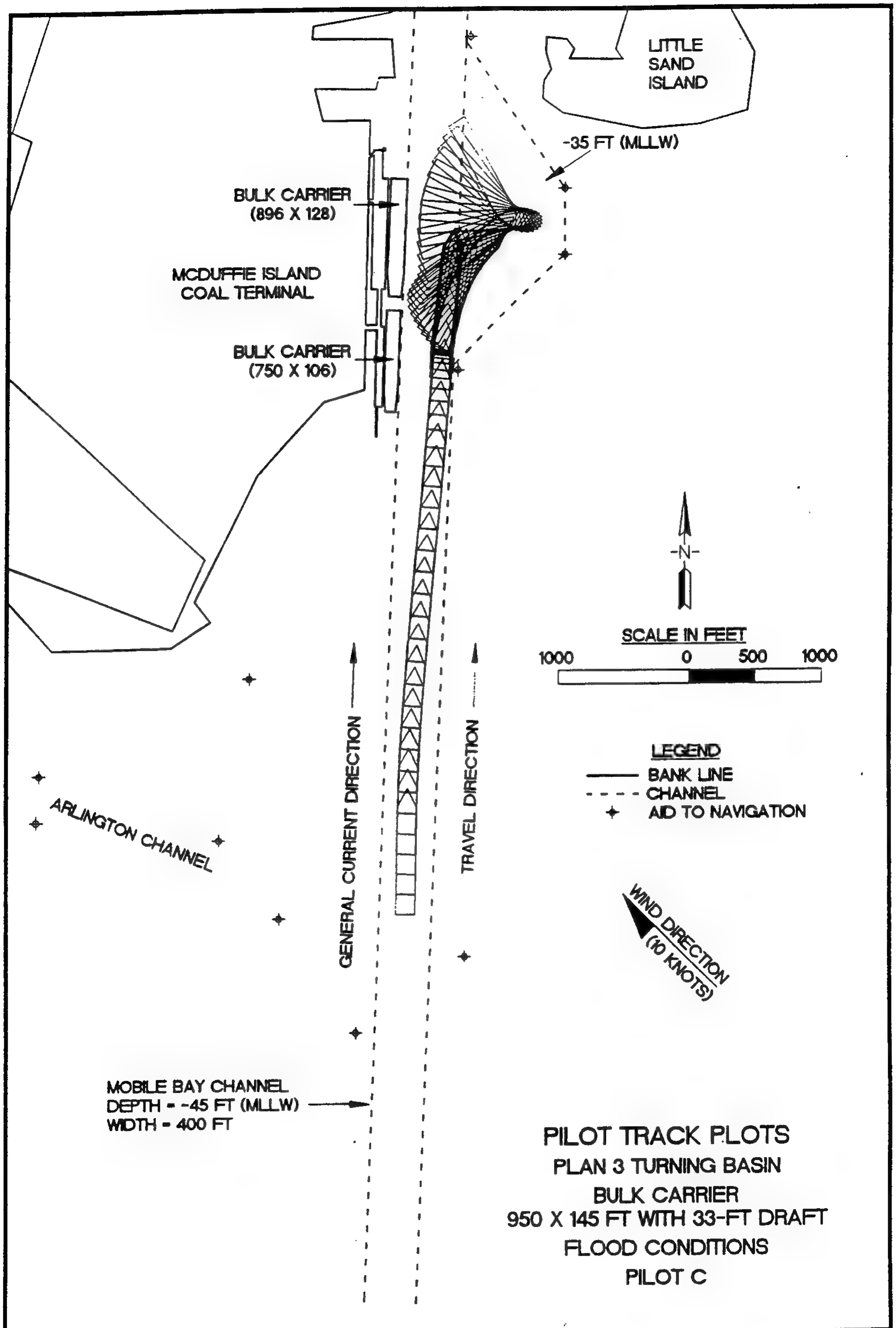
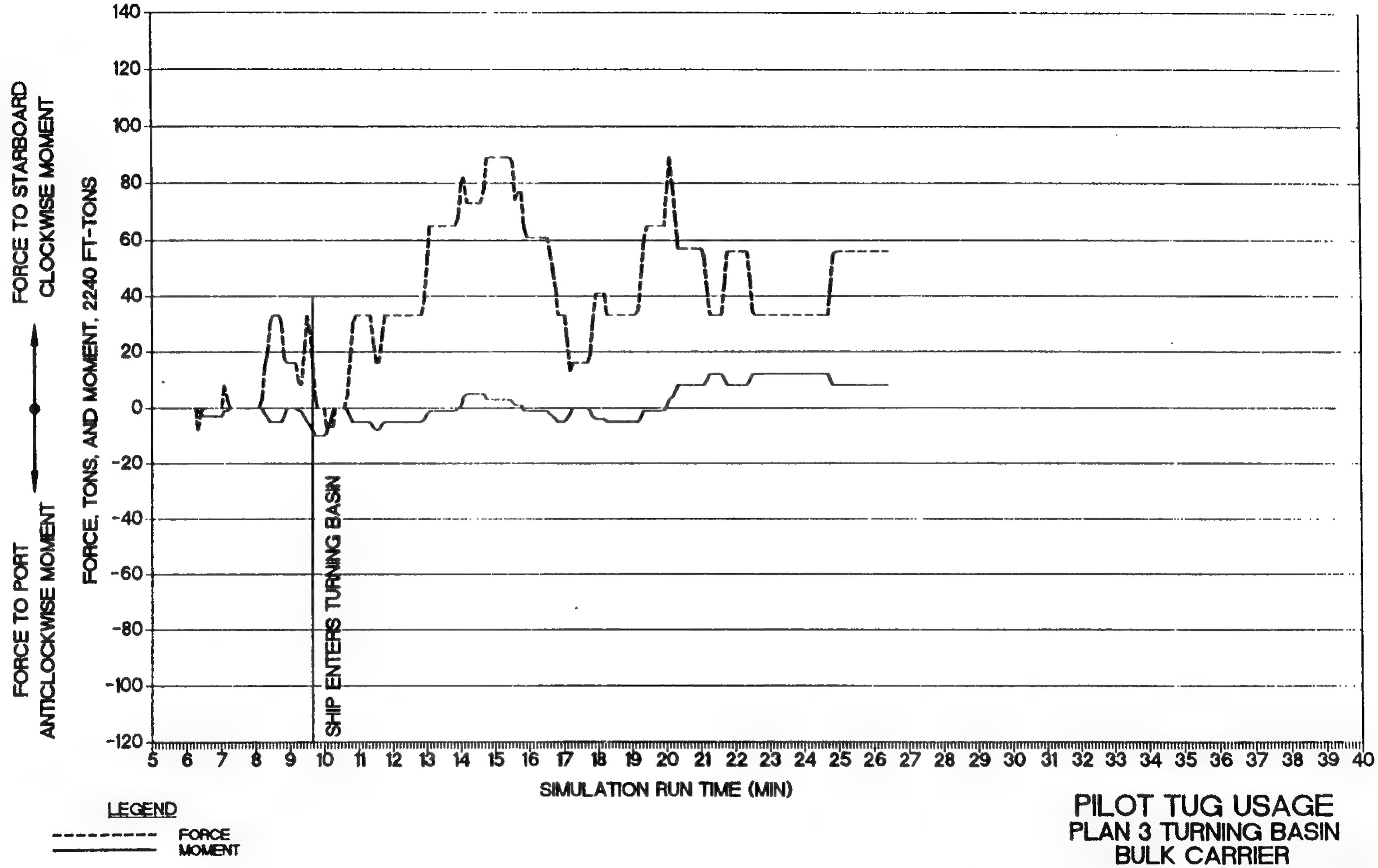

LITTLE SAND ISLAND
-35 FT (MLLW)
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT C



PILOT TUG USAGE
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT C

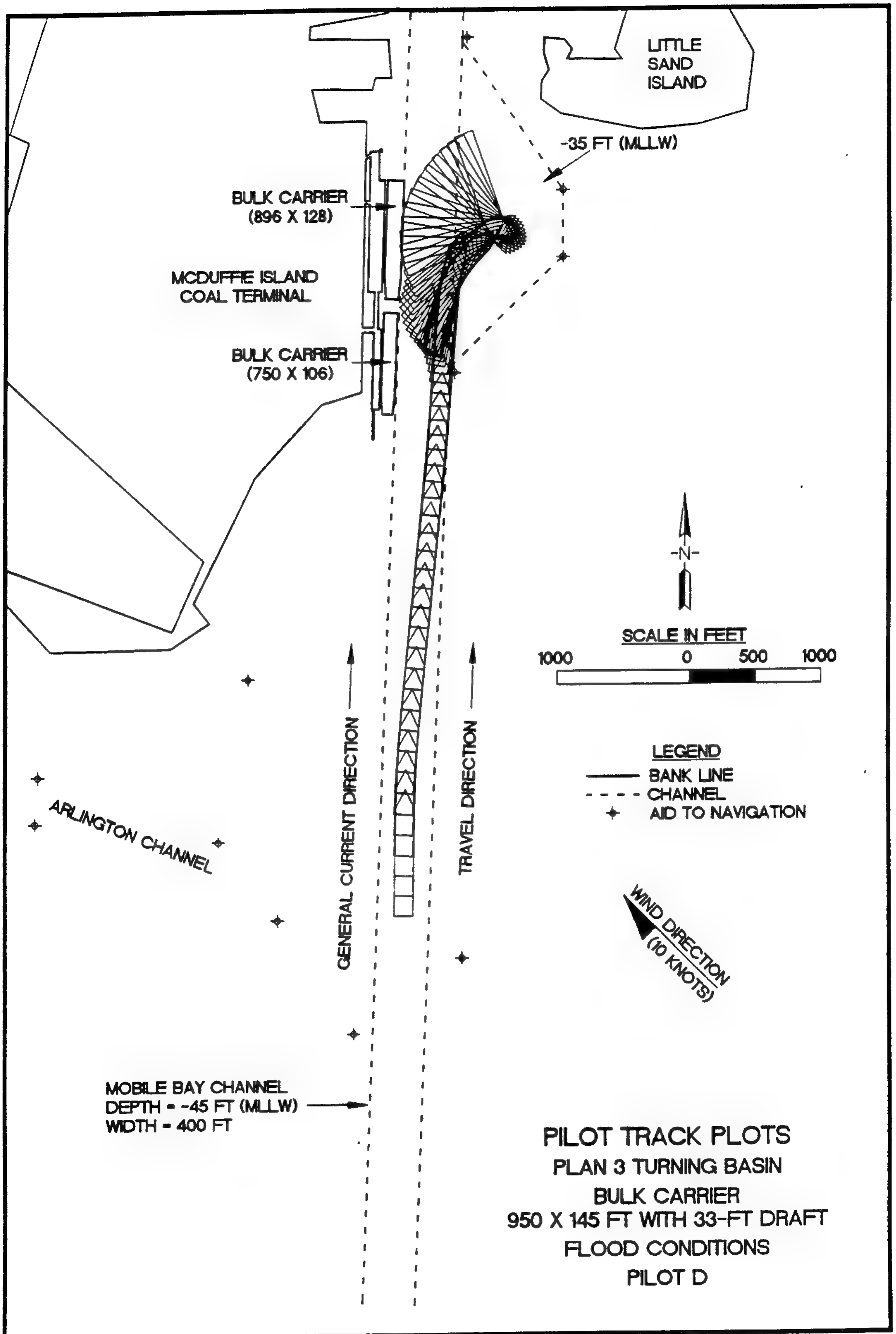
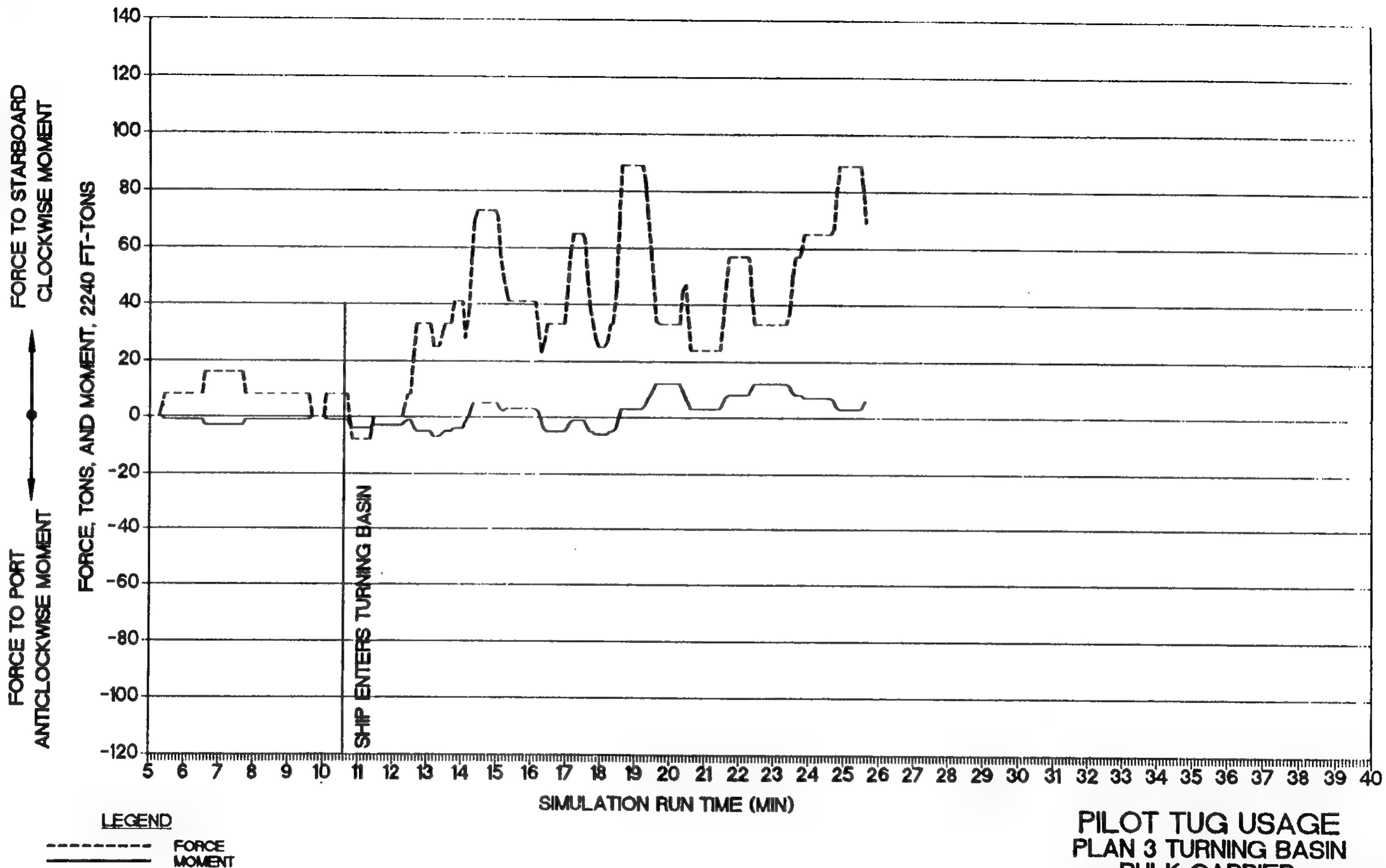

LITTLE
SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT D

Plate 101



PILOT TUG USAGE
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT D

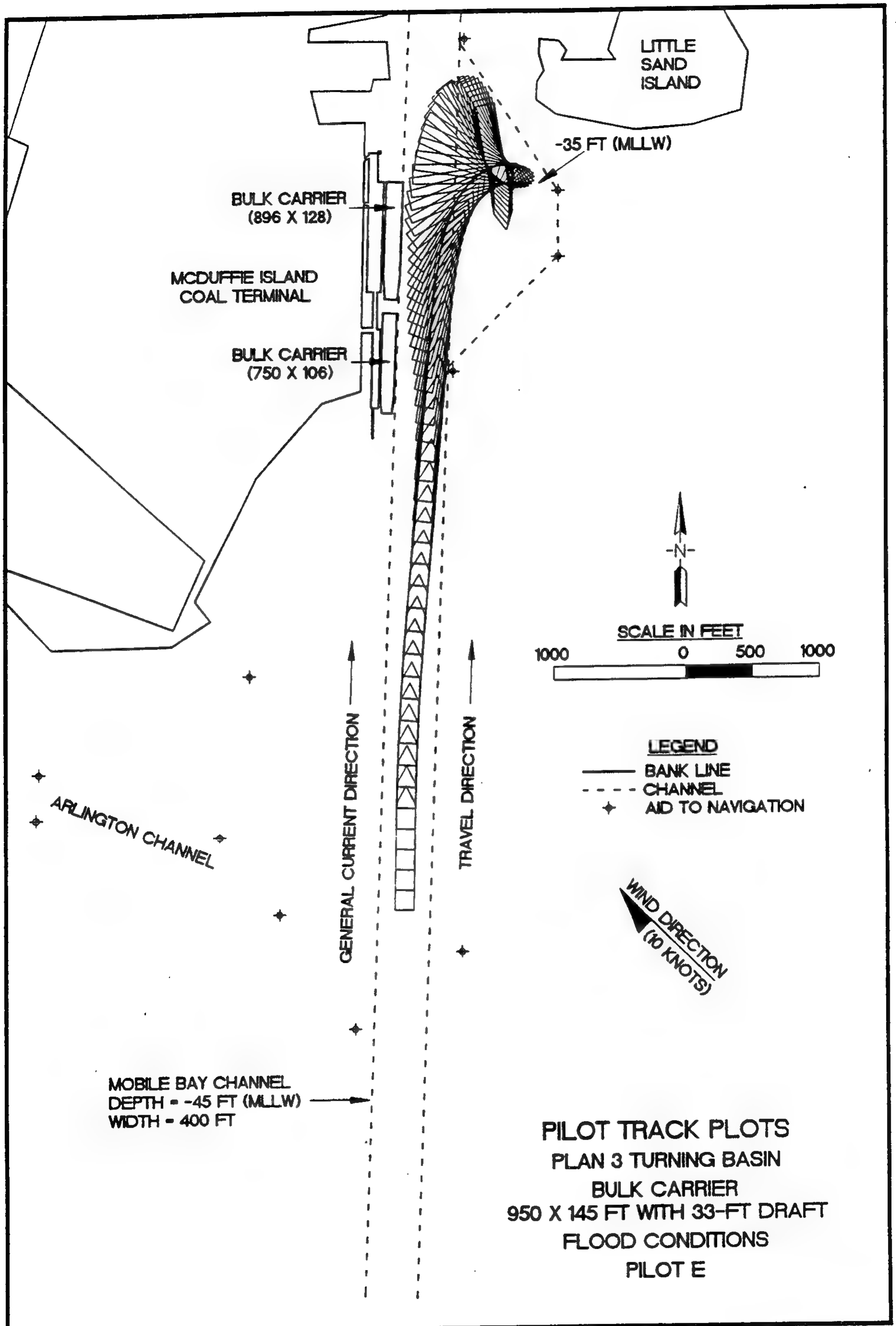
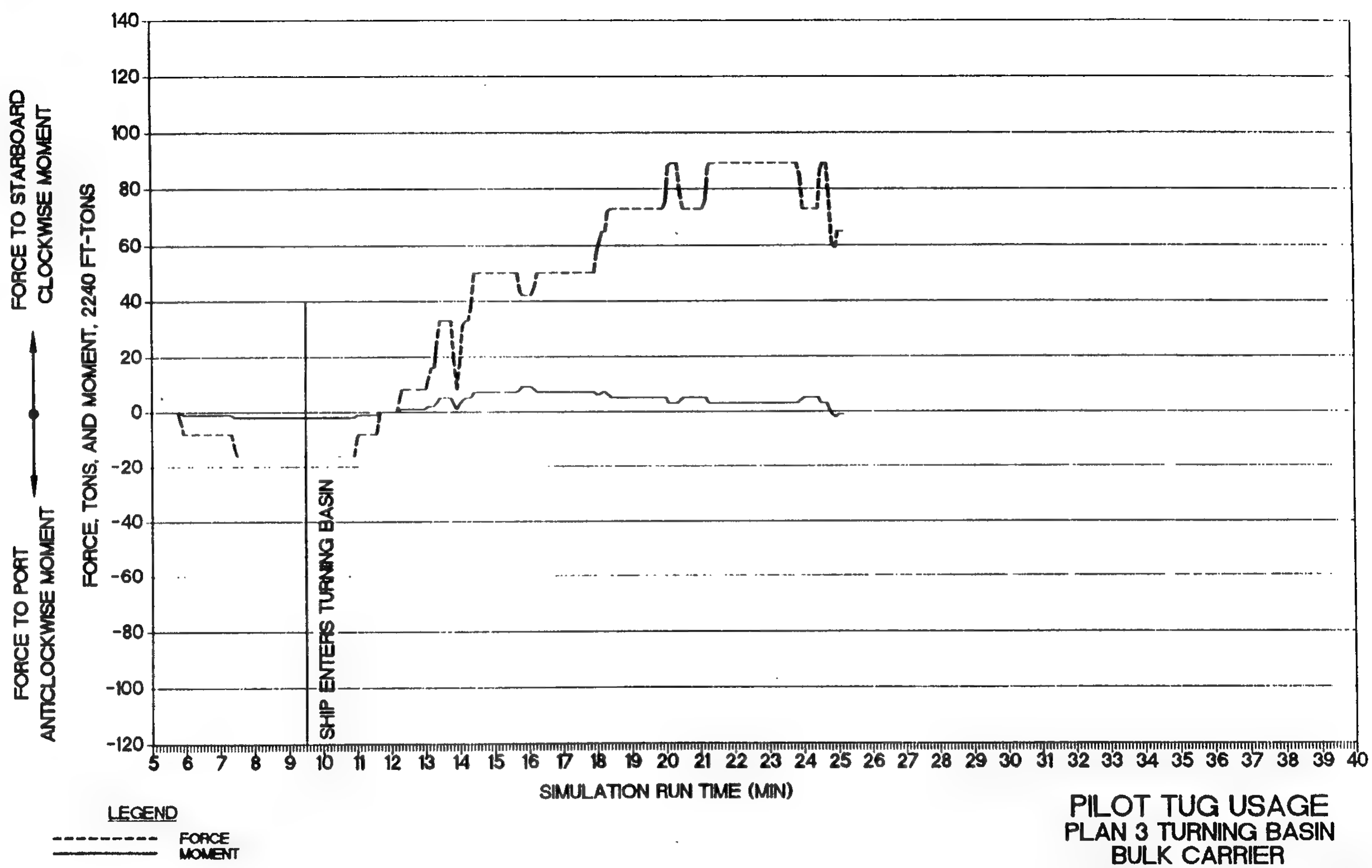
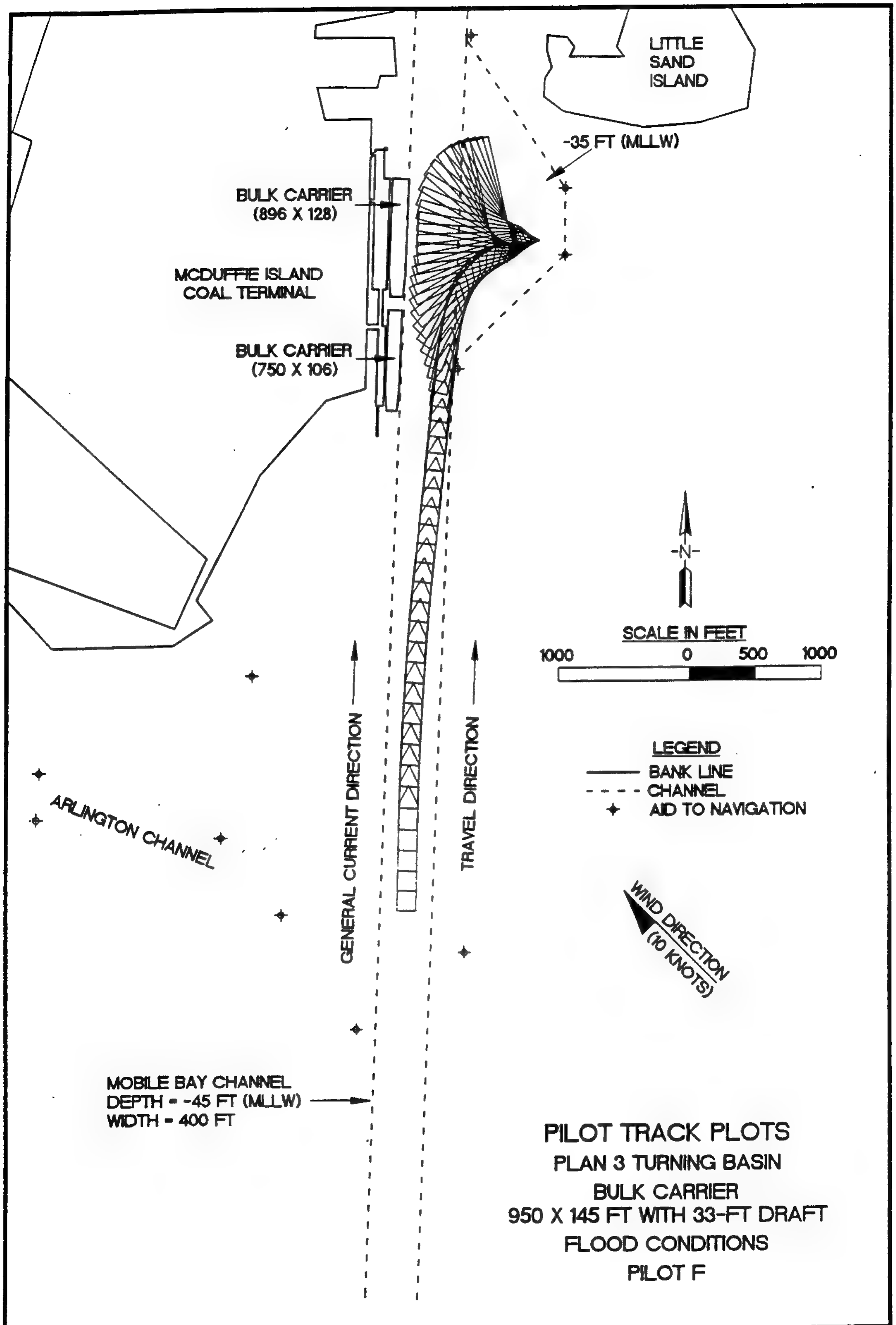
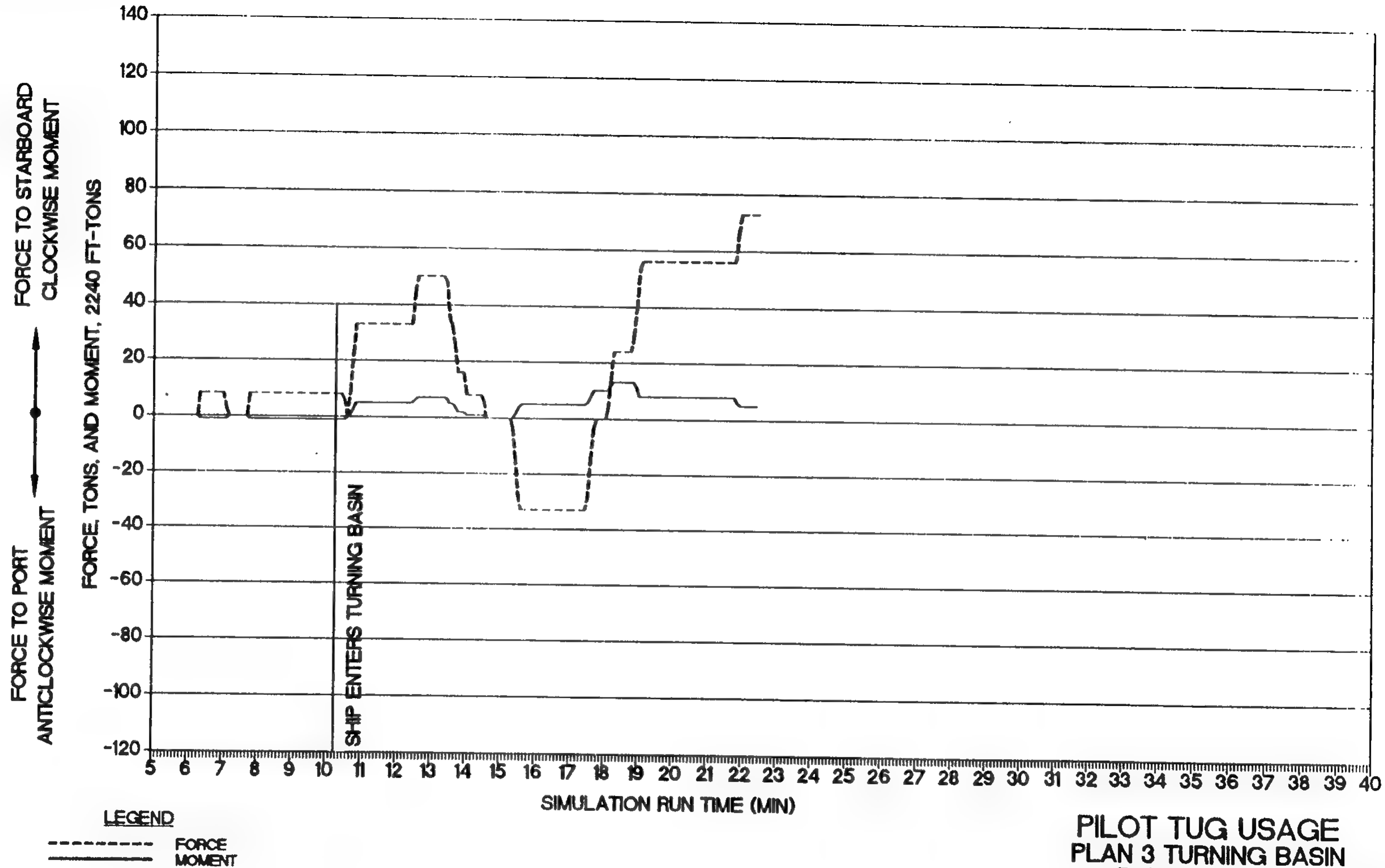

LITTLE
SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000
0
500
1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT E

Plate 103

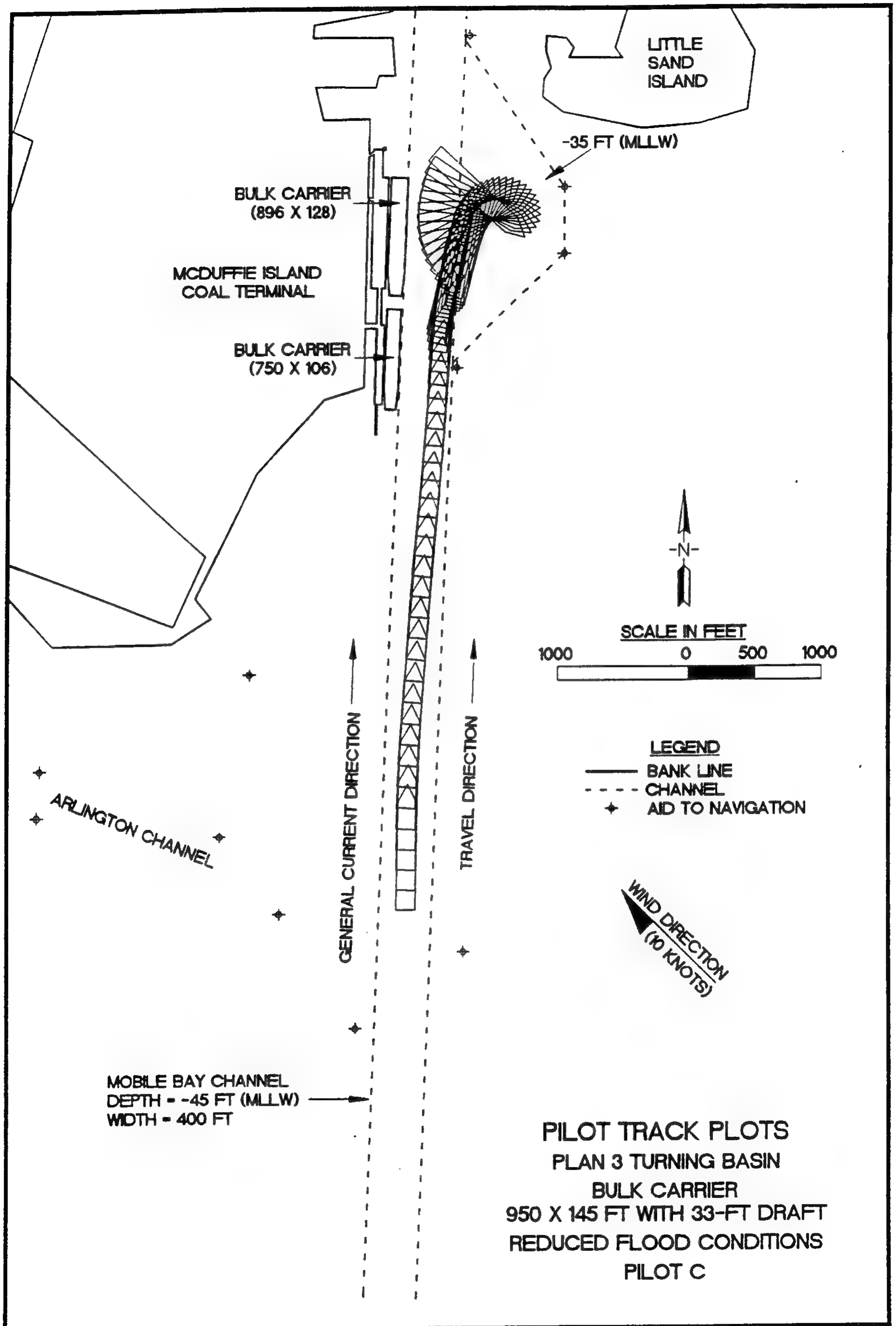


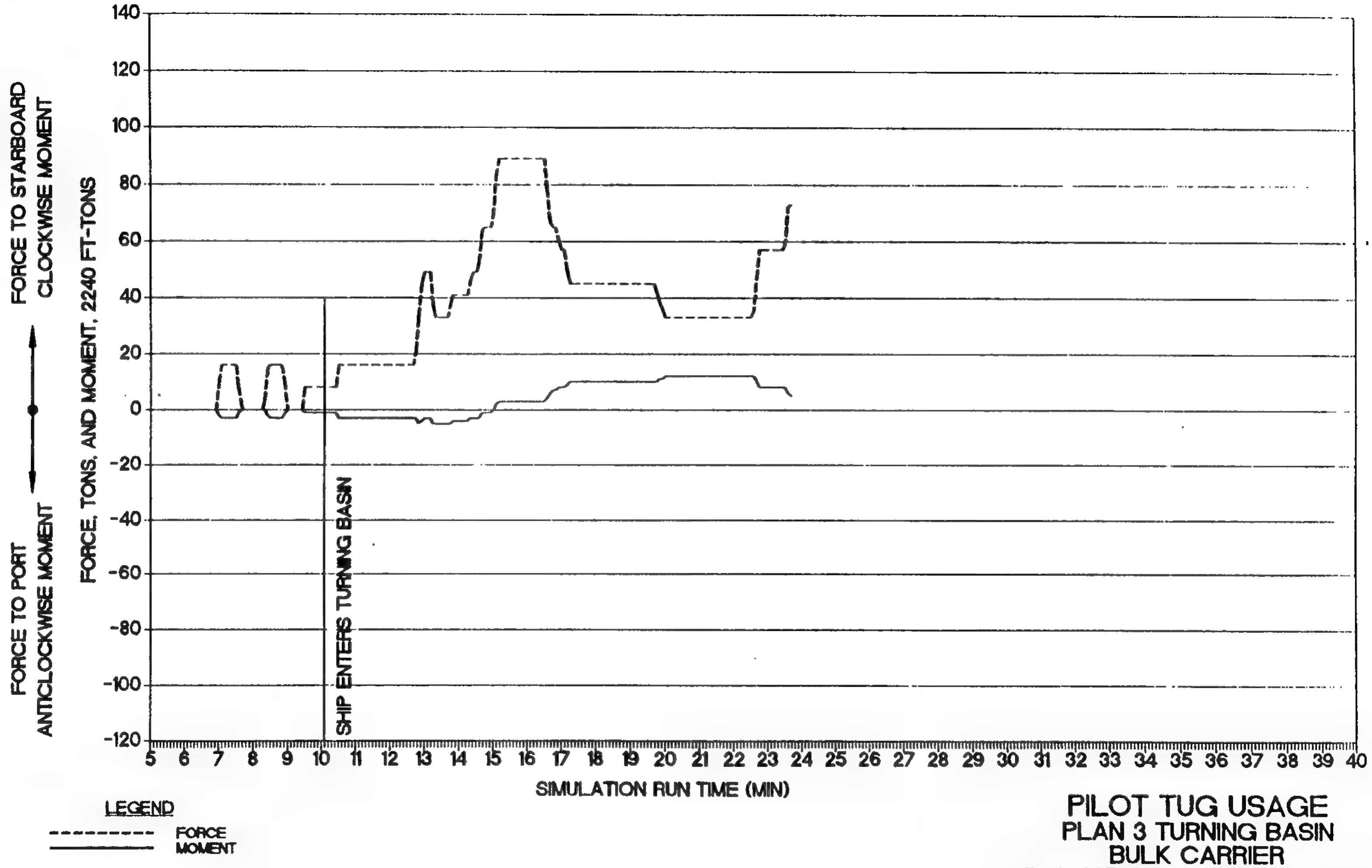
PILOT TUG USAGE
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT E


LITTLE
SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
N
SCALE IN FEET
1000
0
500
1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT F

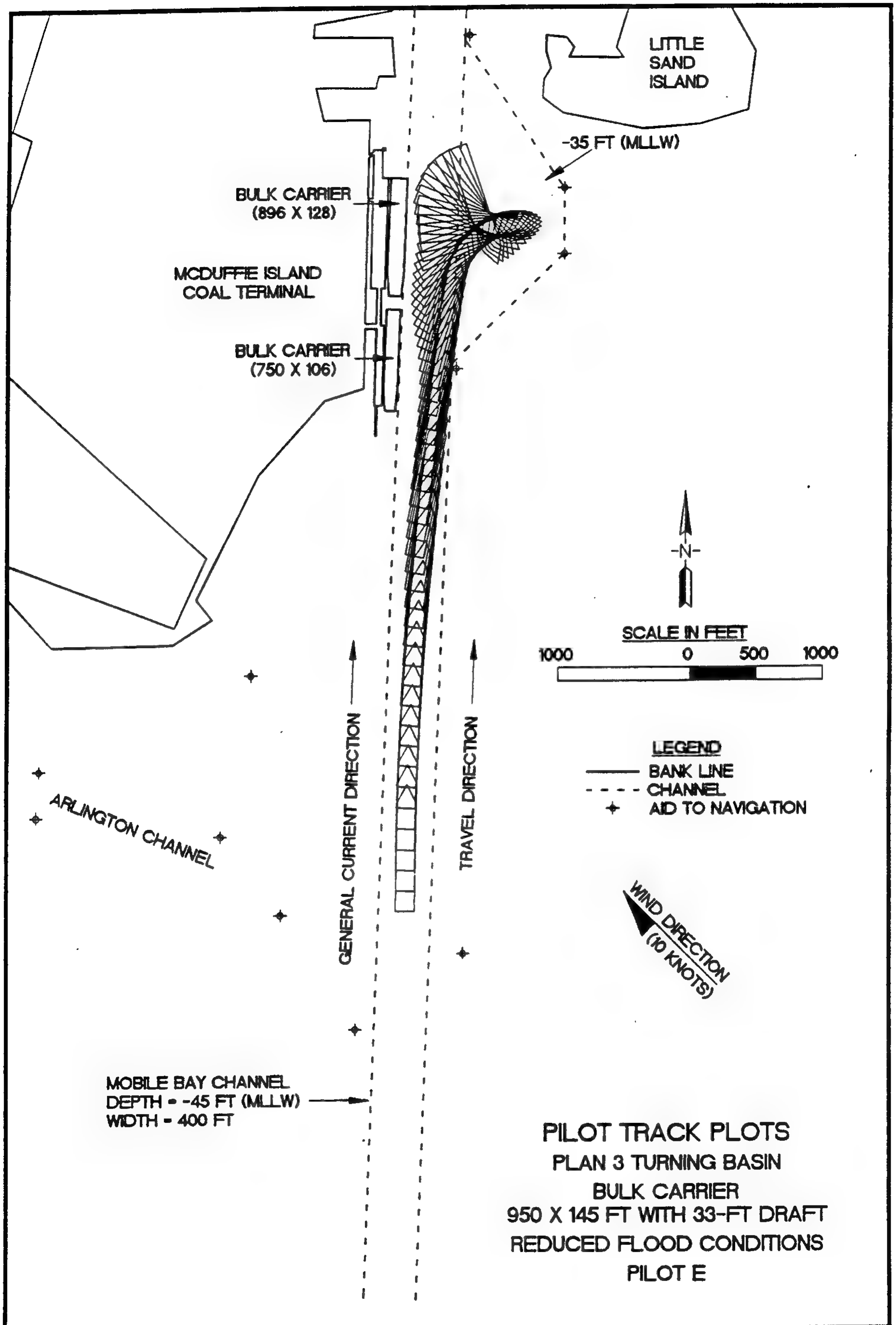


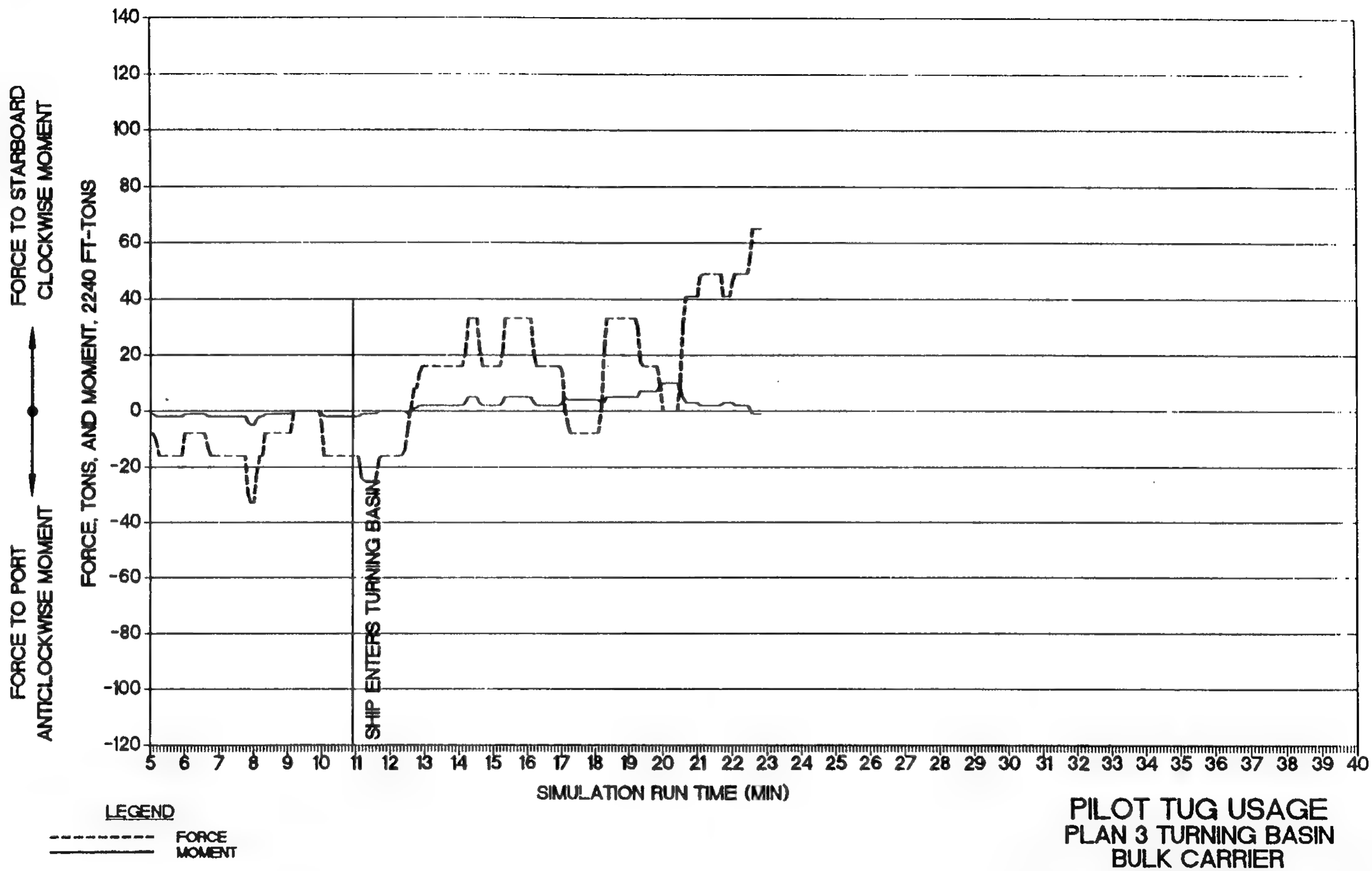
PILOT TUG USAGE
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT F


LITTLE SAND ISLAND
-35 FT (MLLW)
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT C

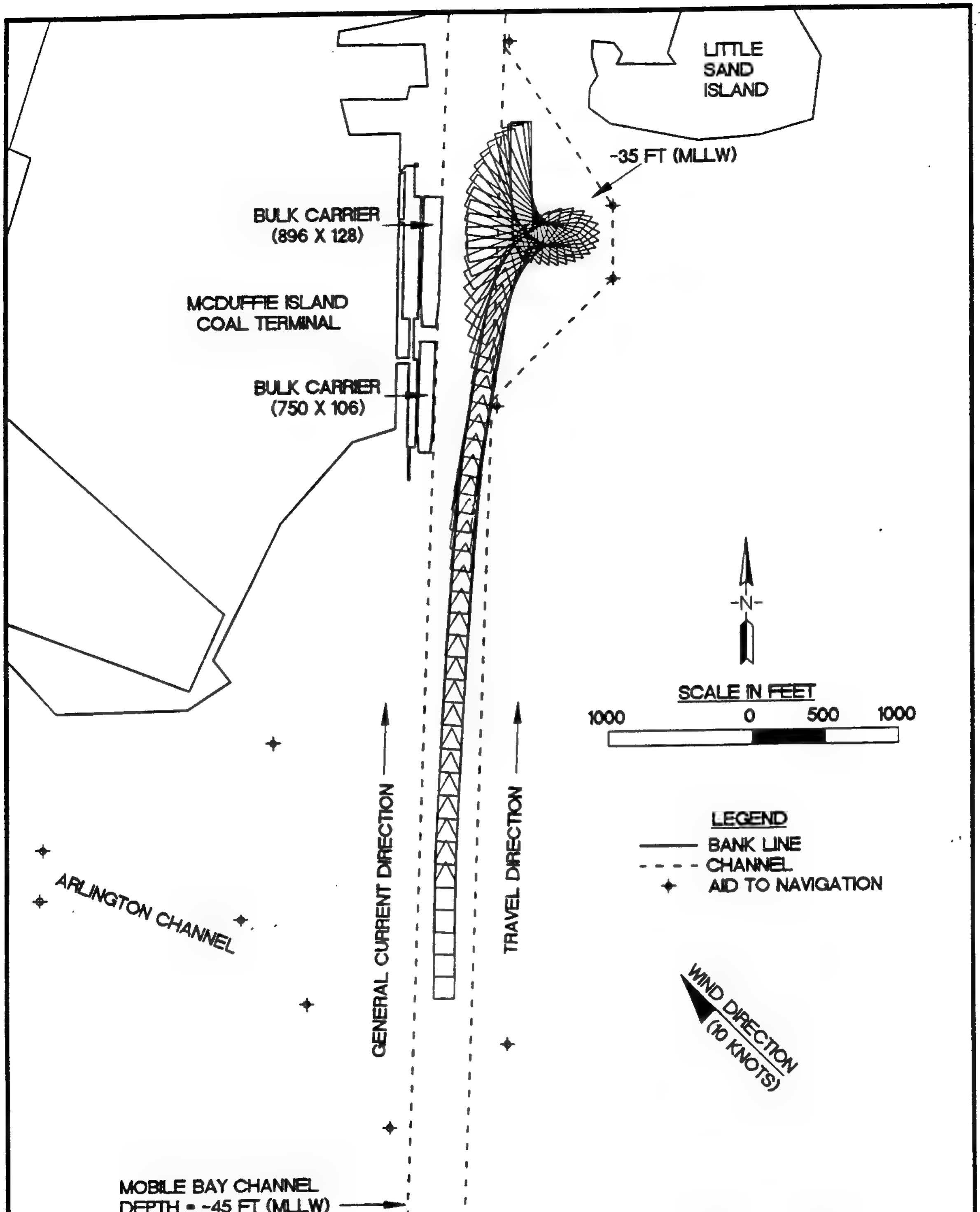


PILOT TUG USAGE
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT C

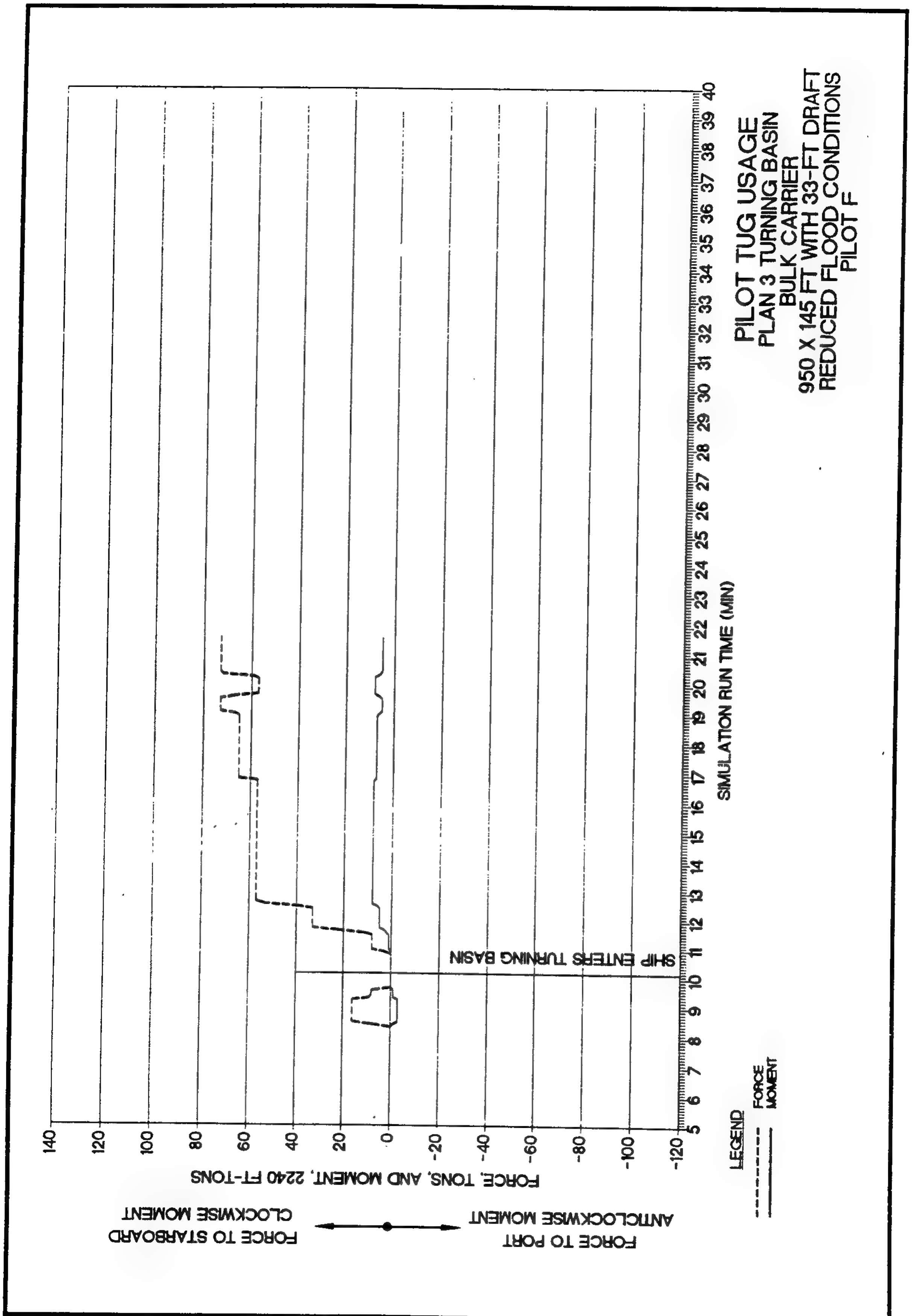

LITTLE SAND ISLAND
-35 FT (MLLW)
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT E



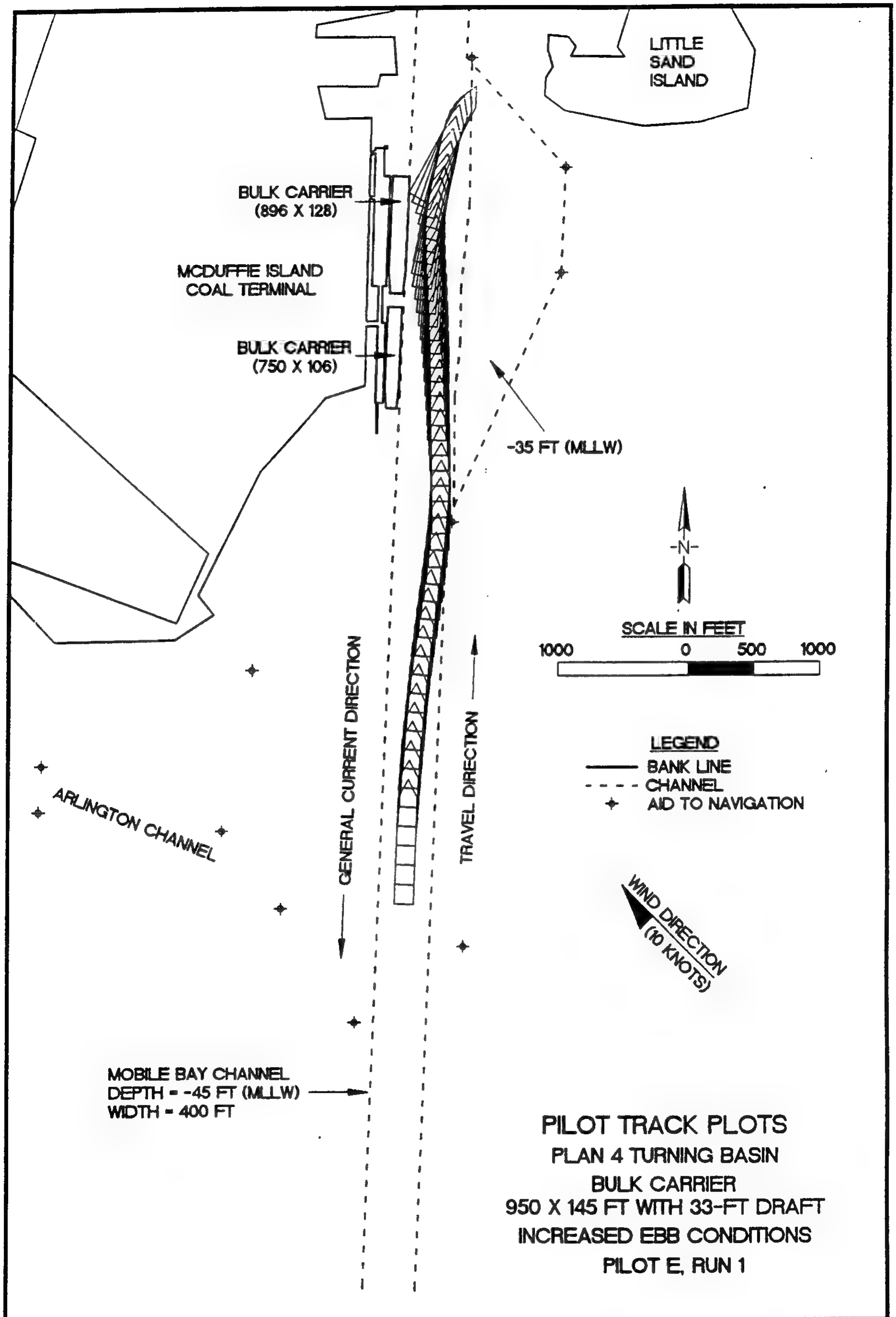
PILOT TUG USAGE
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT E



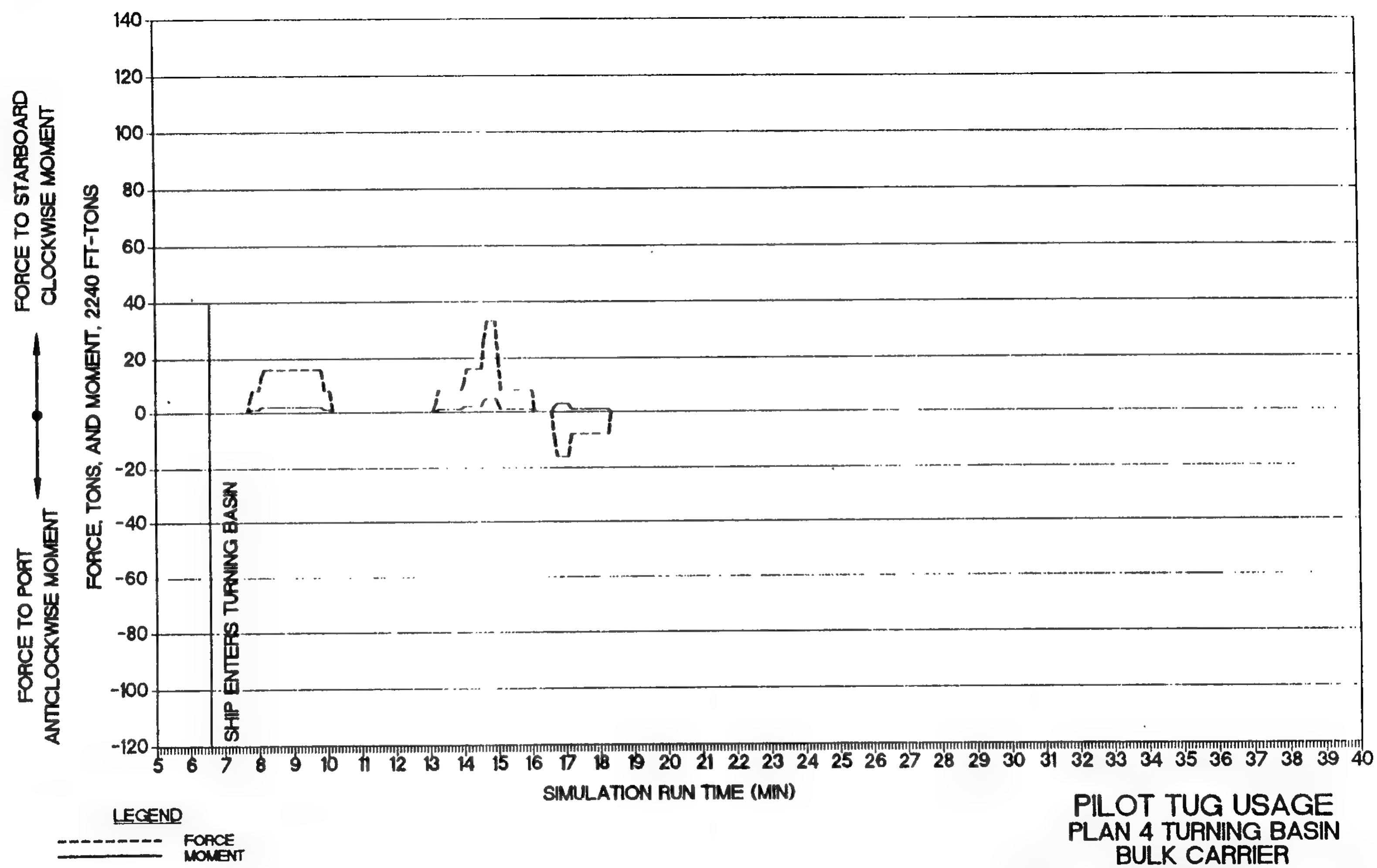
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT F


PILOT TUG USAGE
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT F
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
FORCE
MOMENT

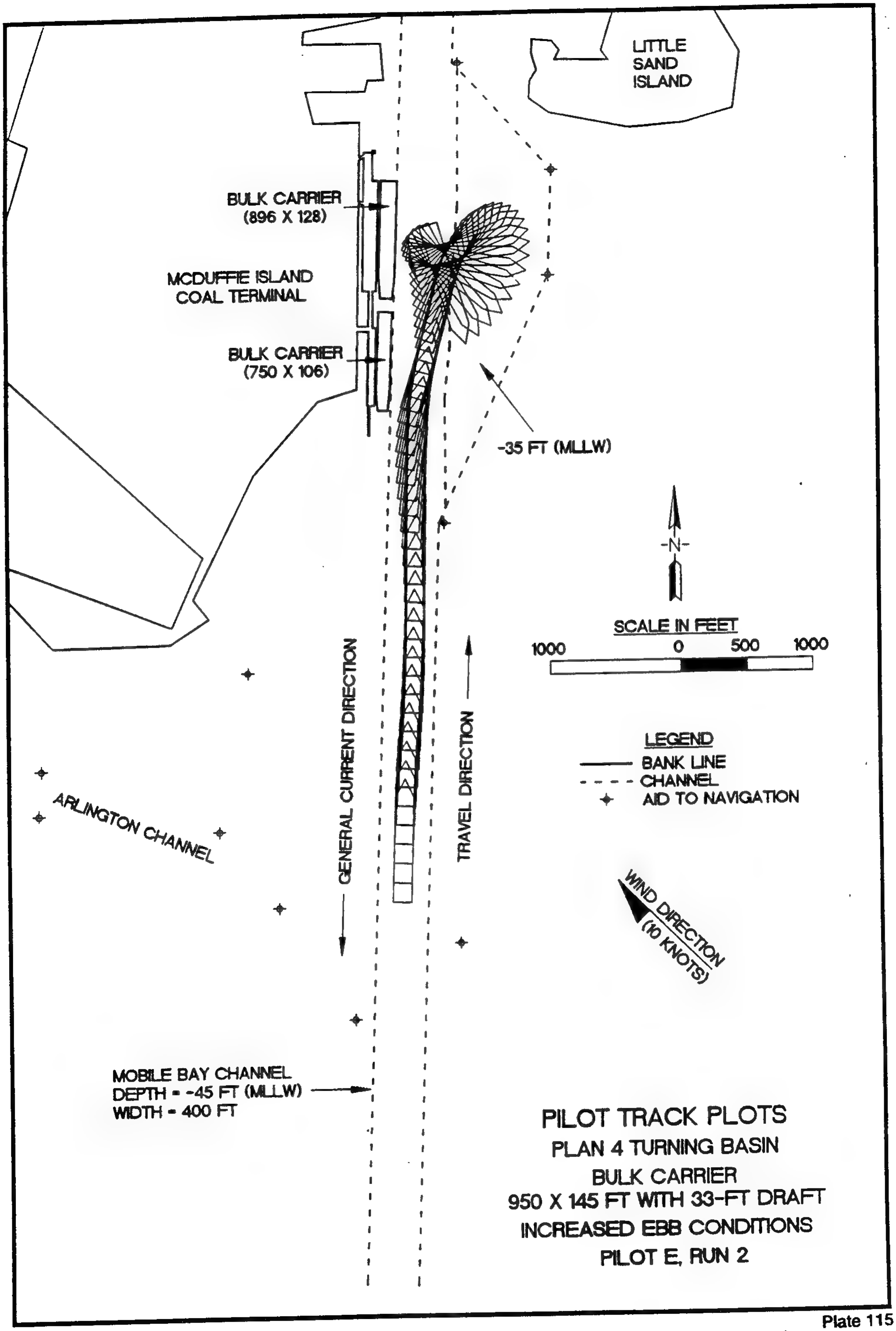
Plan 4 Results



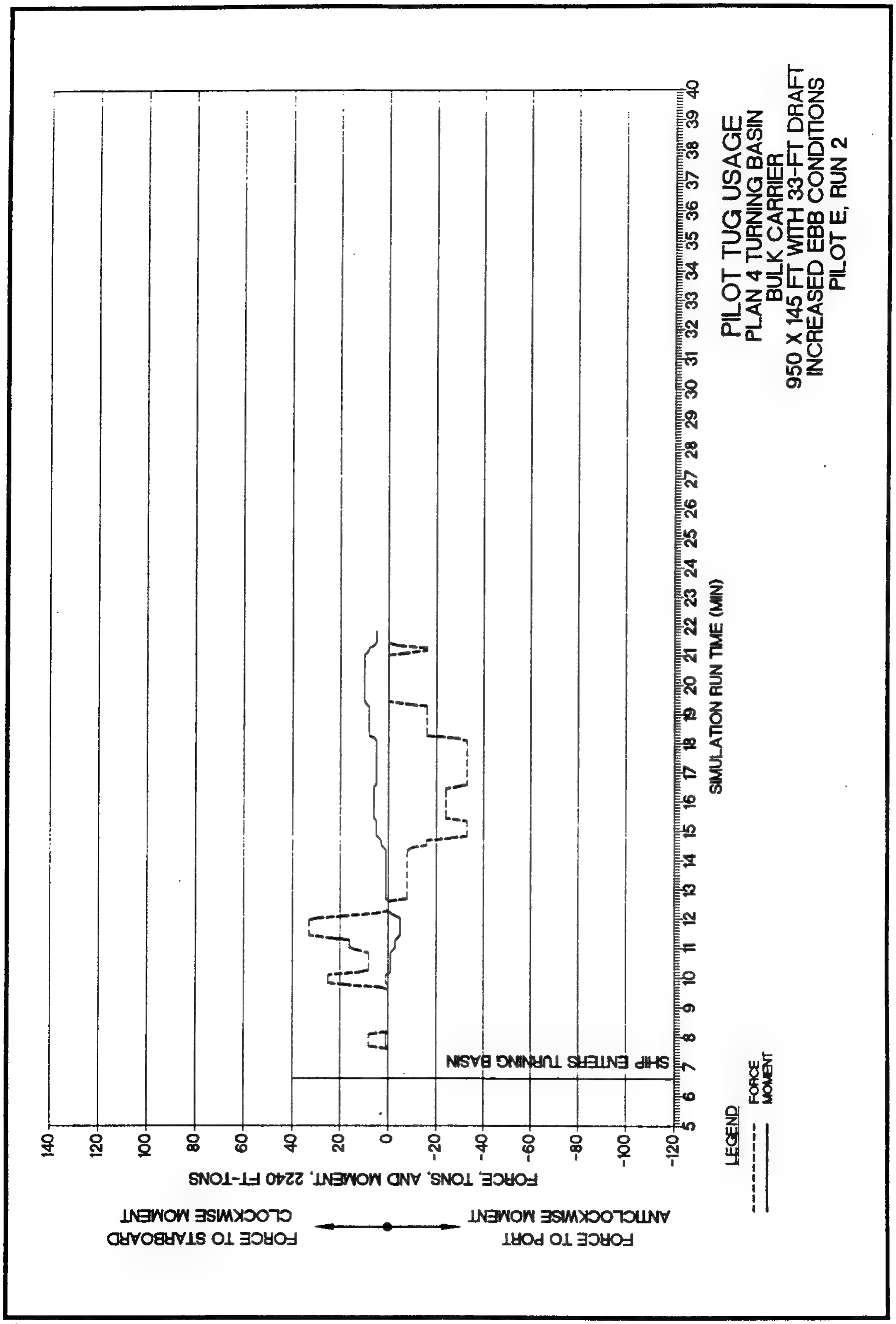
LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT E, RUN 1



PILOT TUG USAGE
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT E, RUN 1



PILOT TRACK PLOTS
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT E, RUN 2


PILOT TUG USAGE
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT E, RUN 2
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
FORCE
MOMENT
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
5
6
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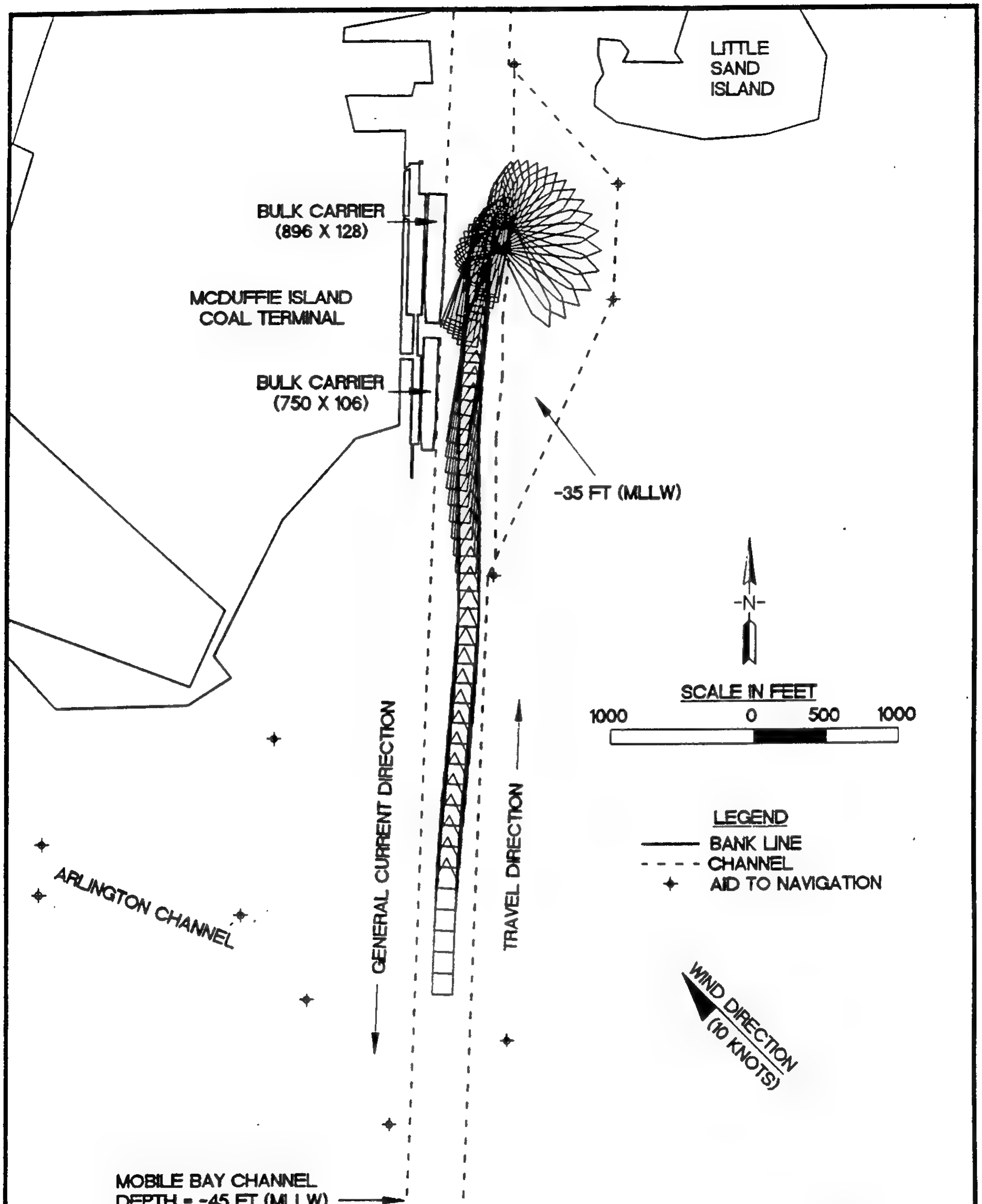
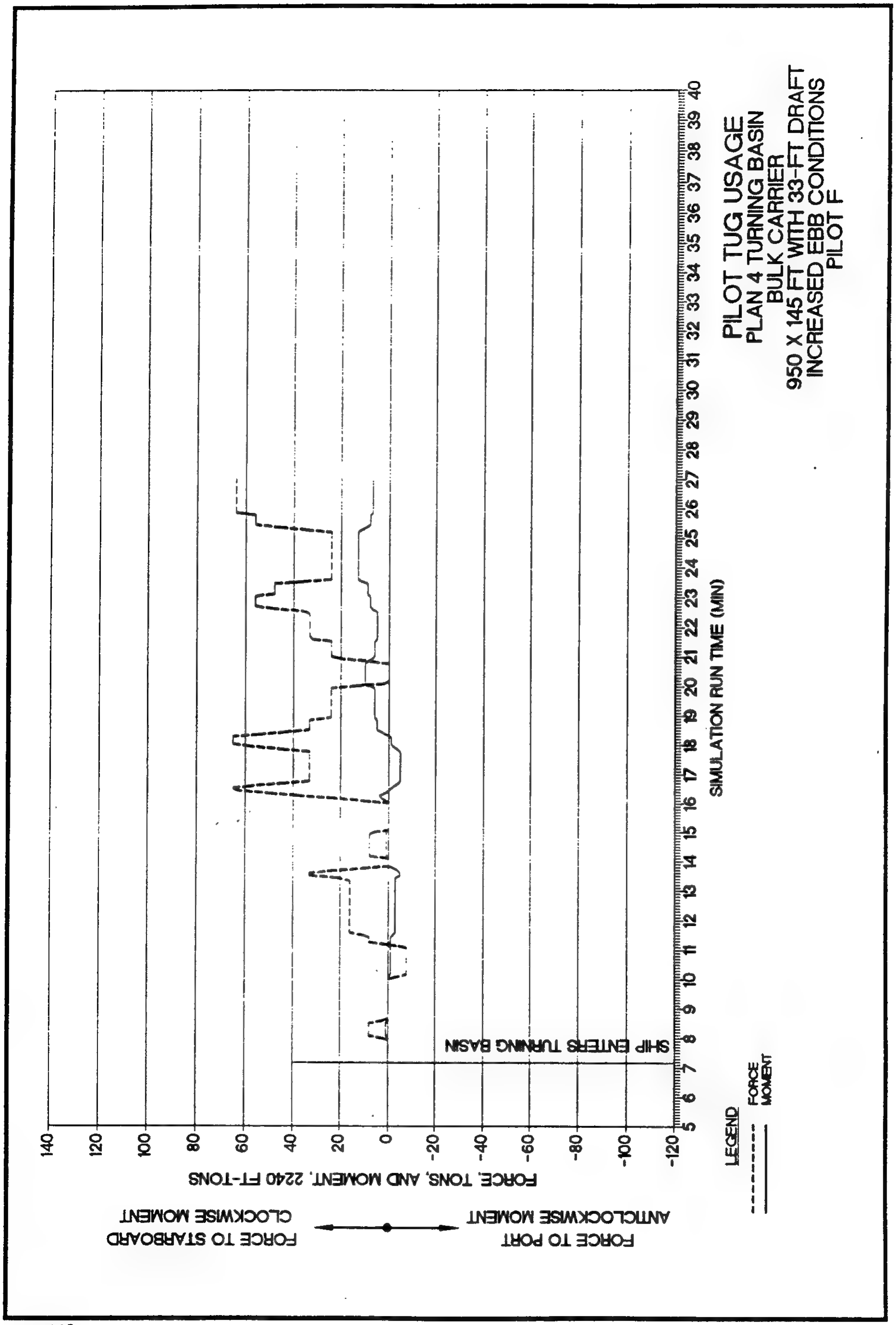
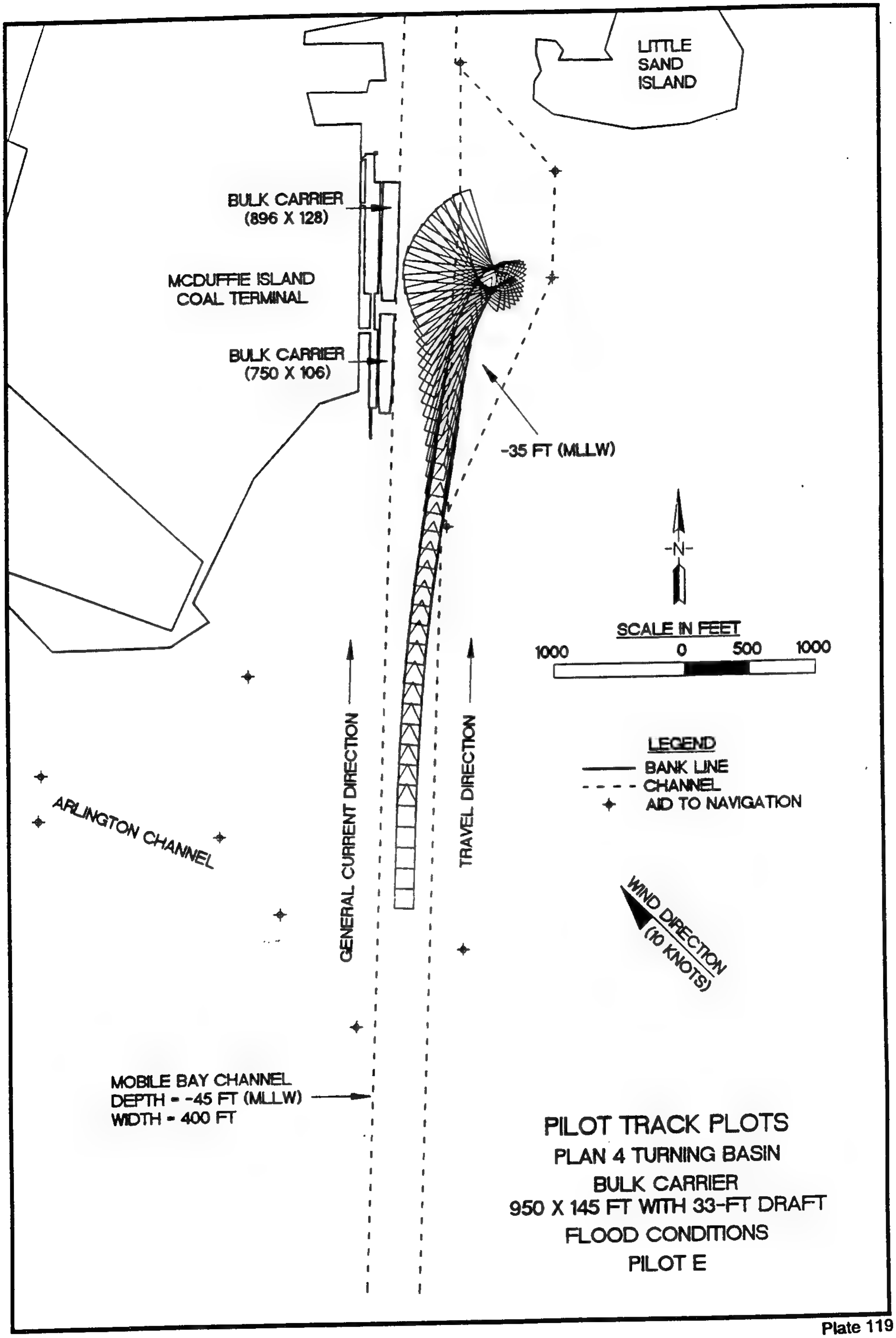
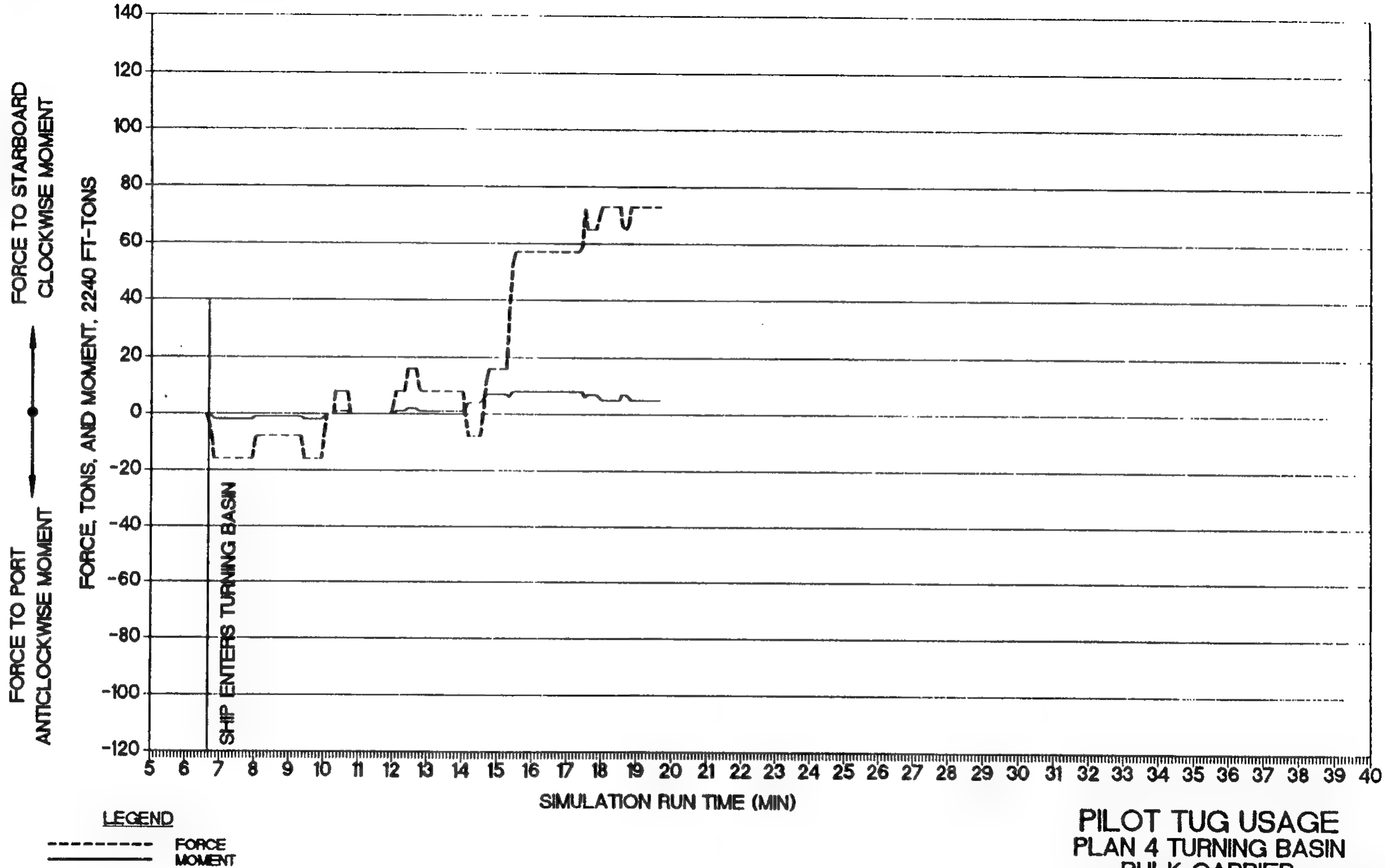


PILOT TRACK PLOTS
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT F

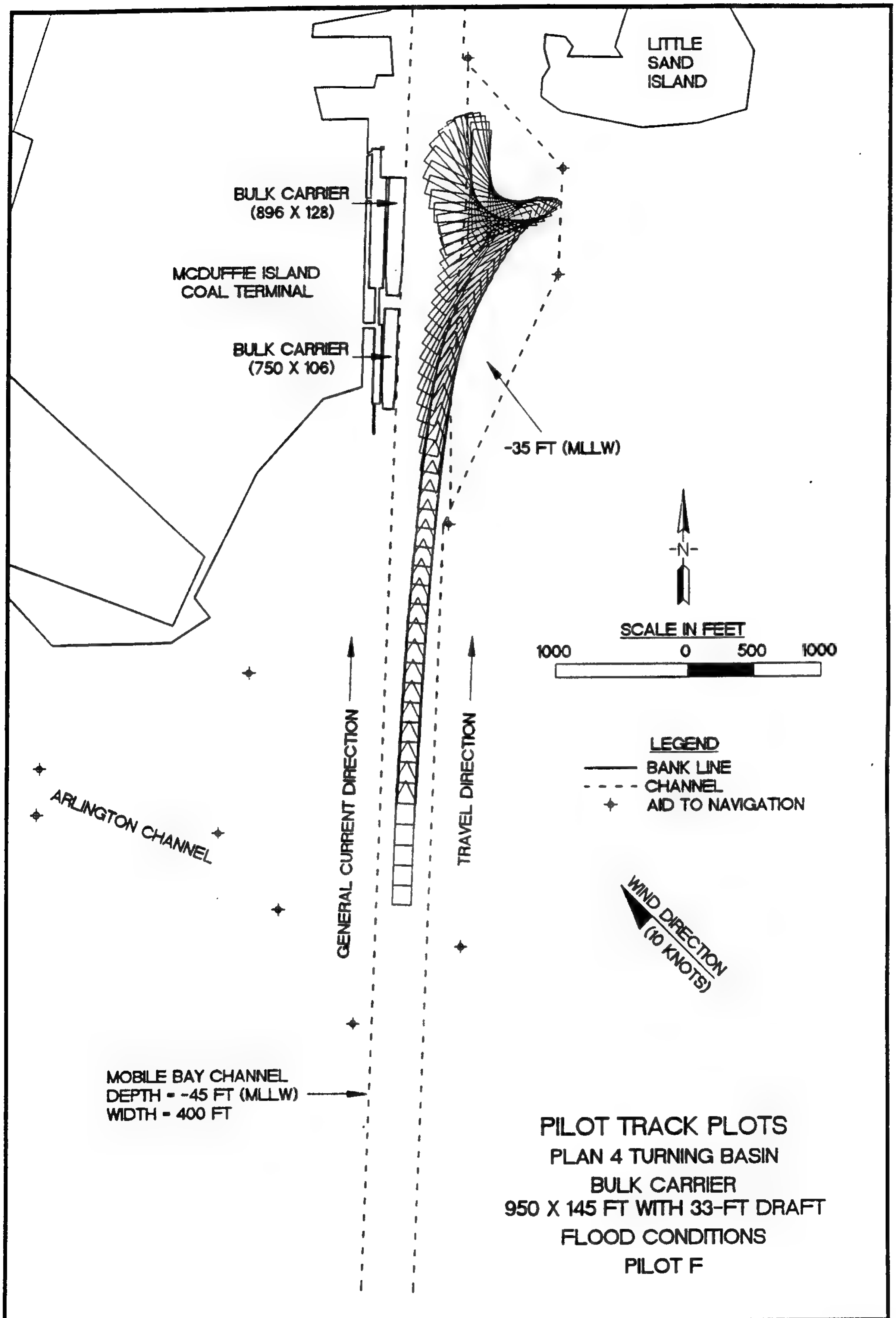


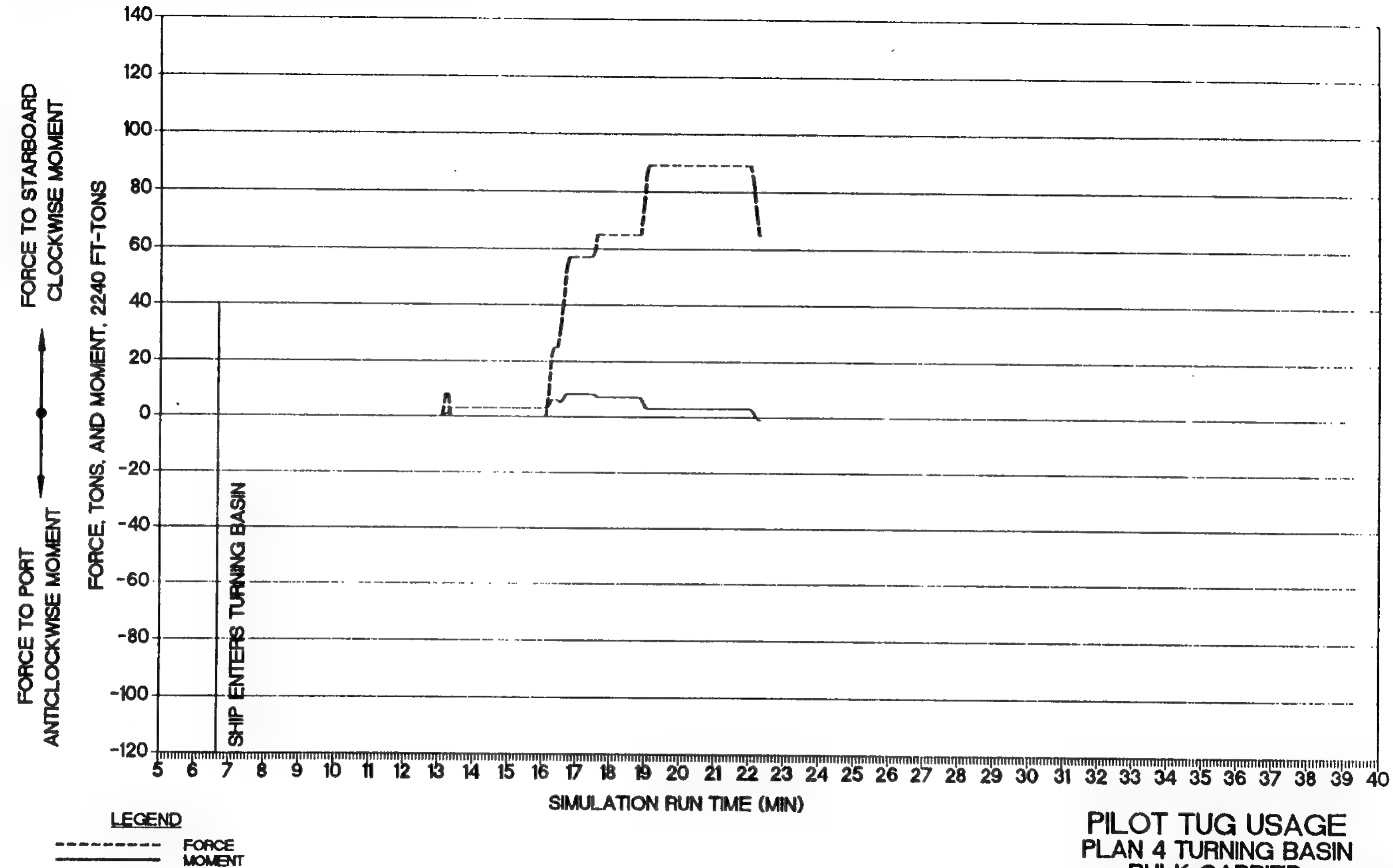
PILOT TUG USAGE
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
PILOT F


LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000
0
500
1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT E

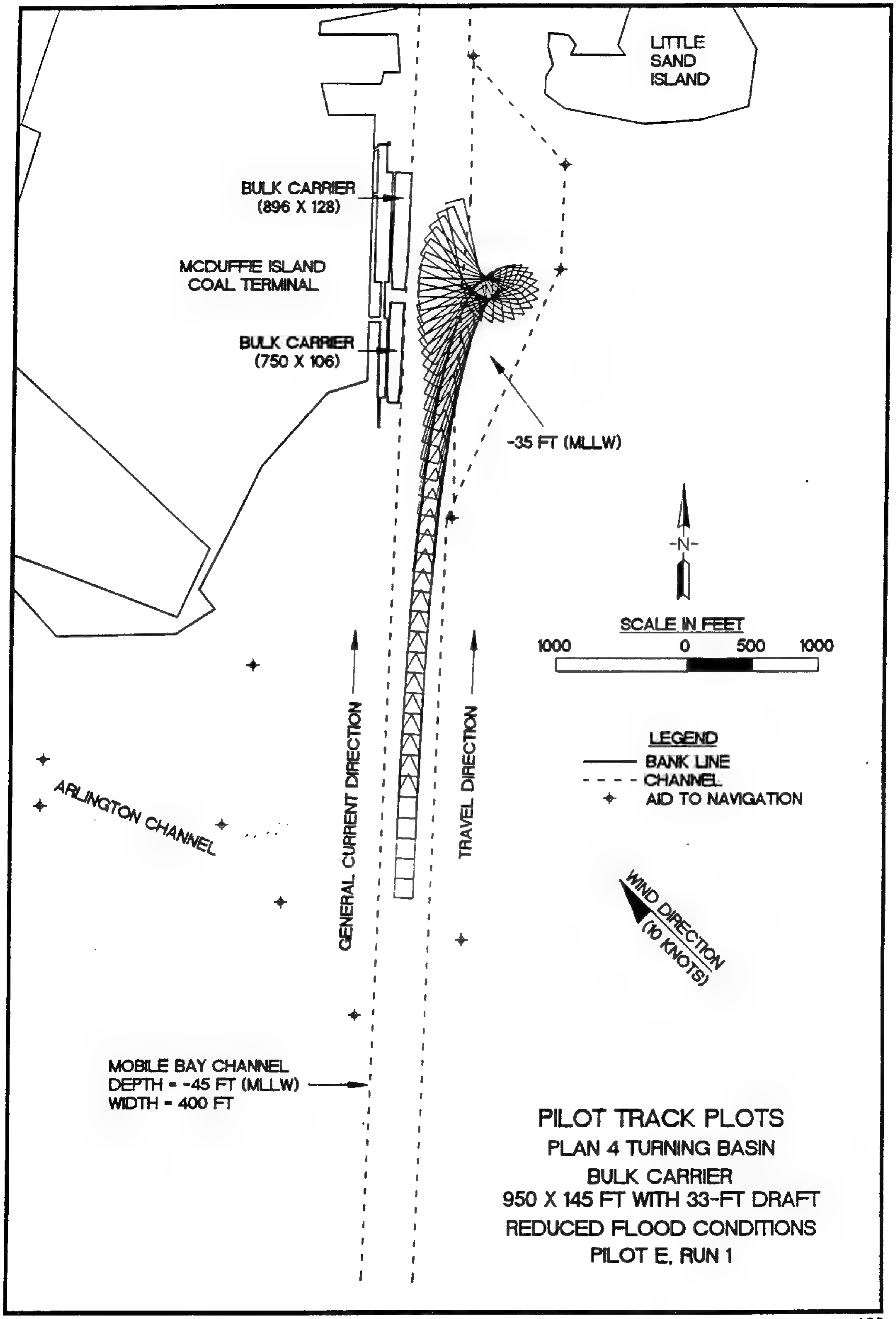


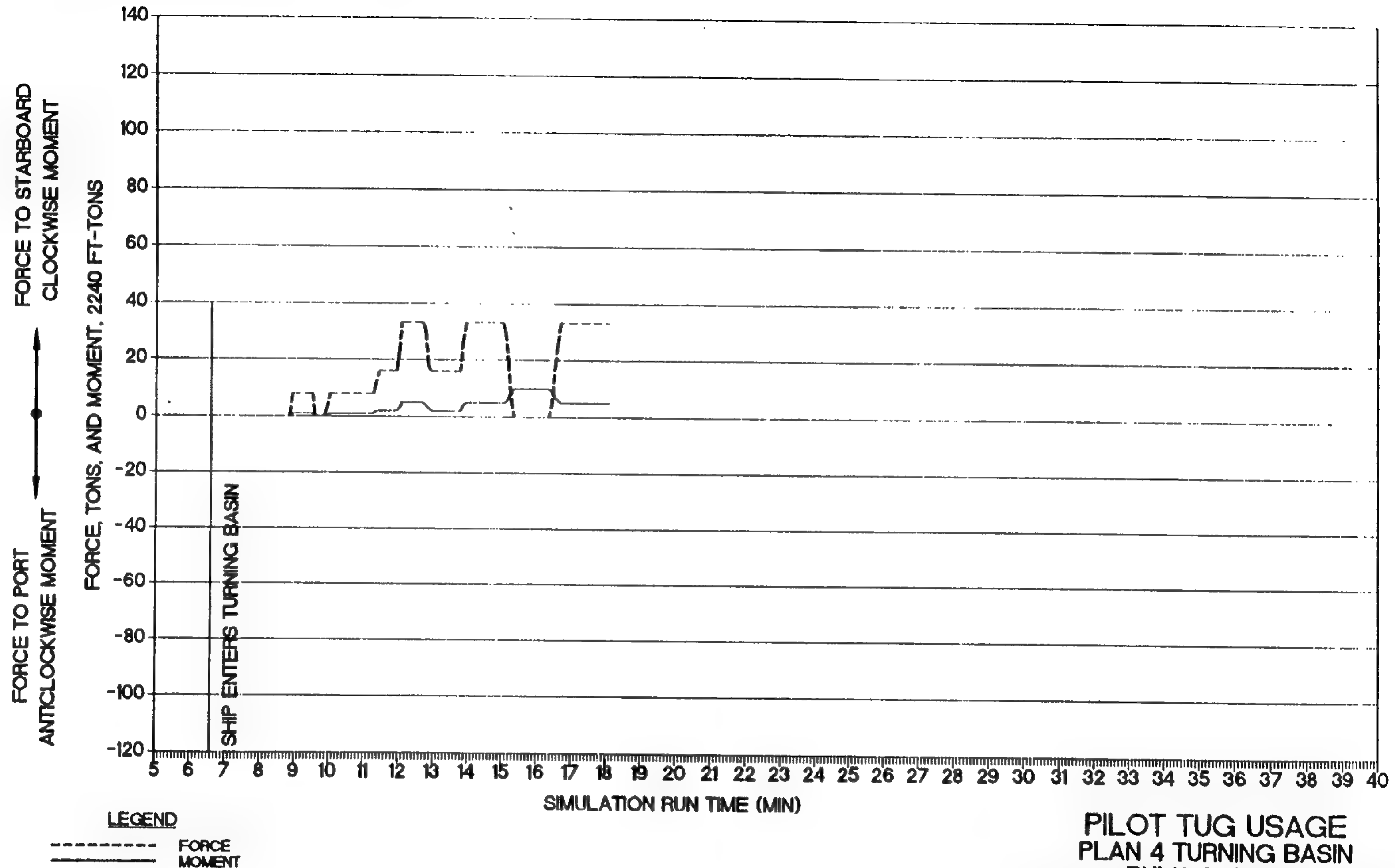
PILOT TUG USAGE
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT E


LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT F

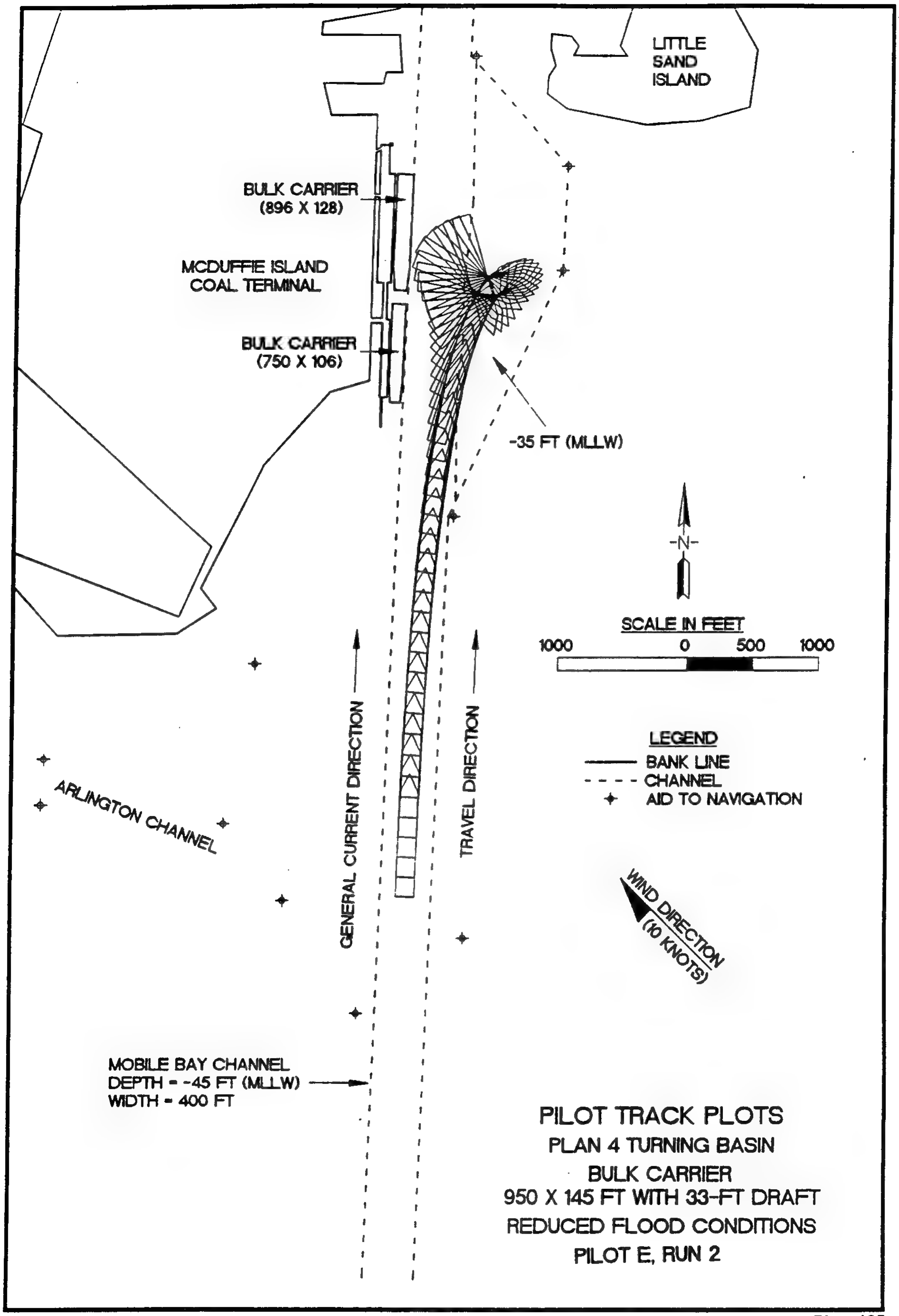


PILOT TUG USAGE
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
PILOT F

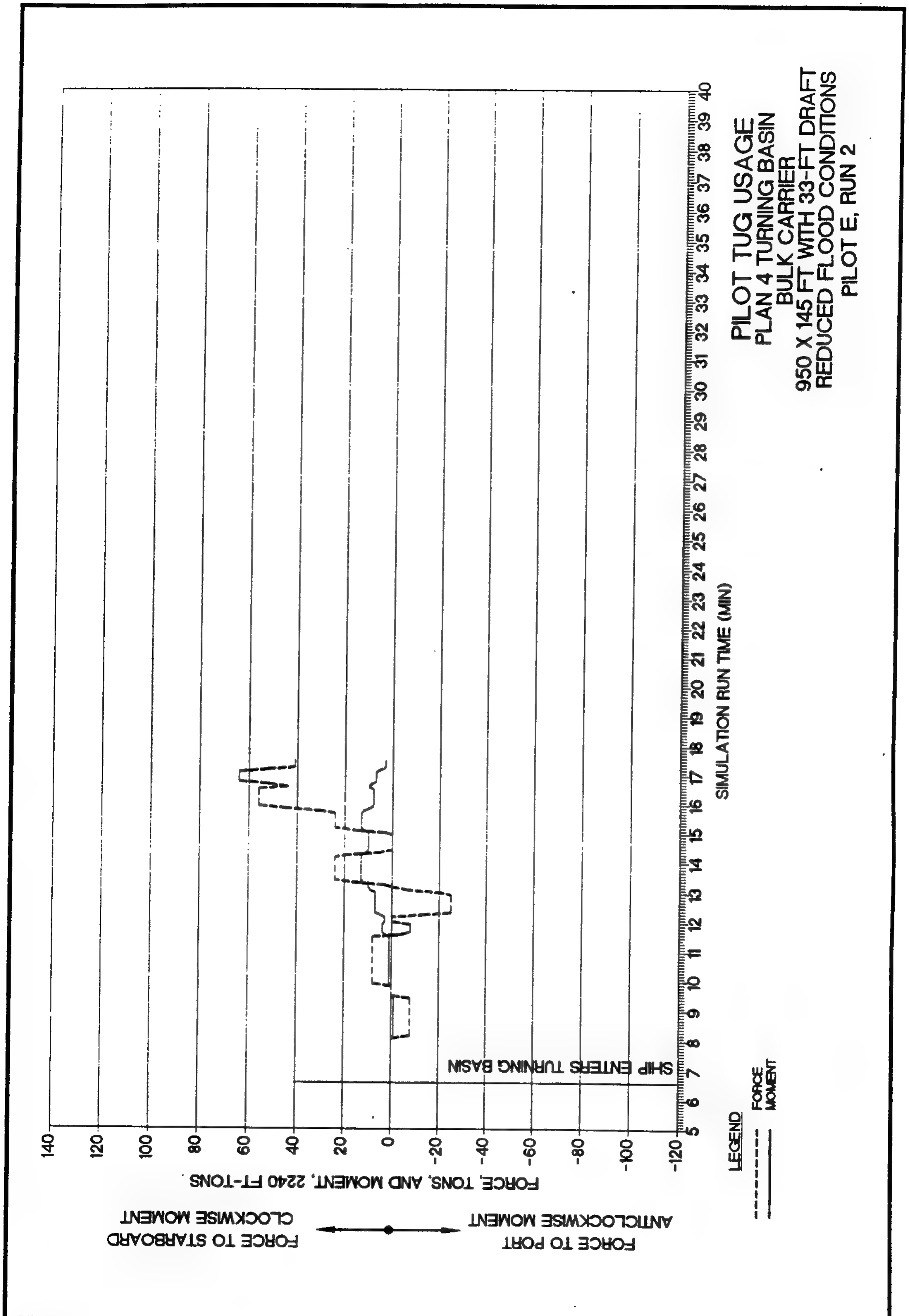

LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT E, RUN 1

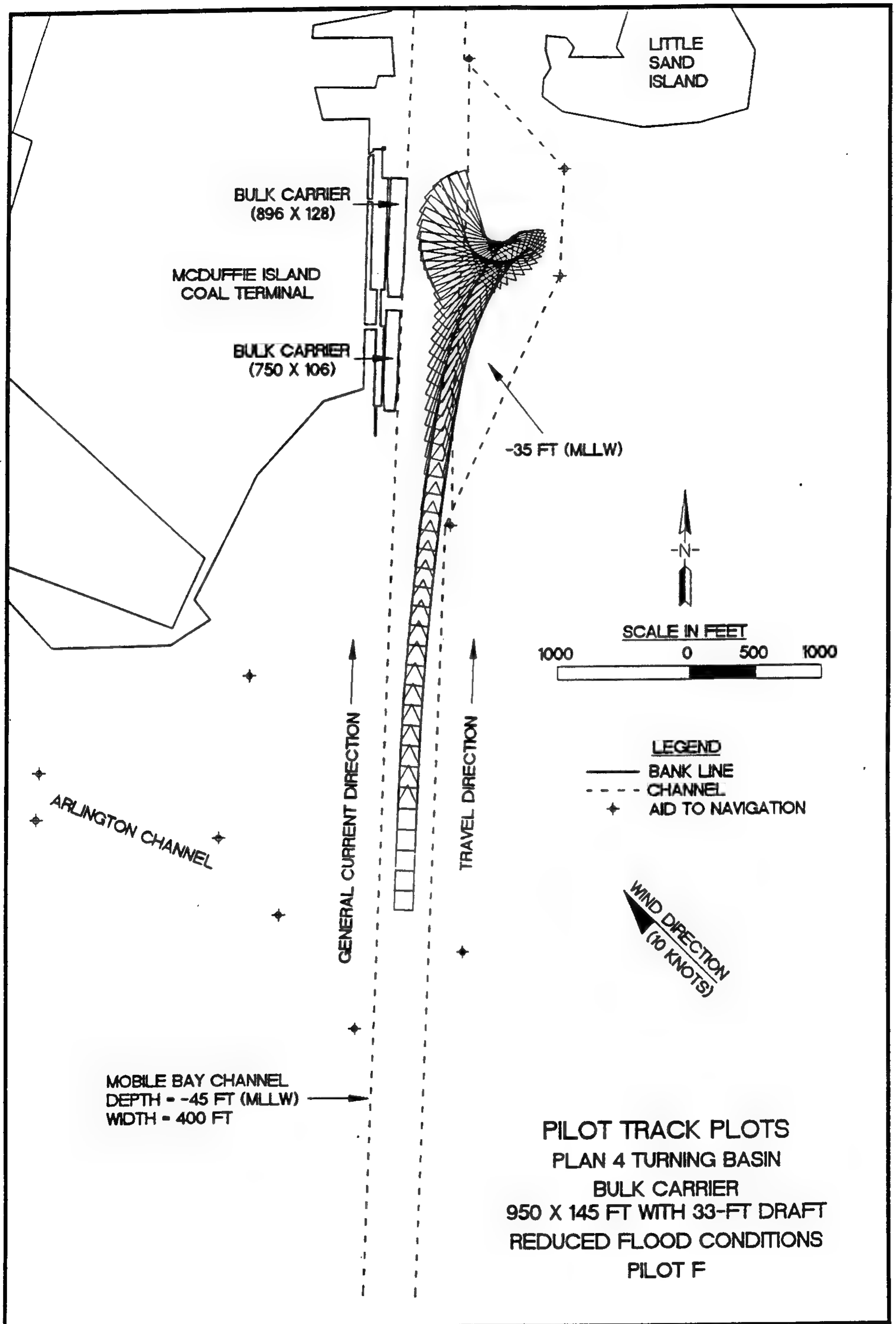


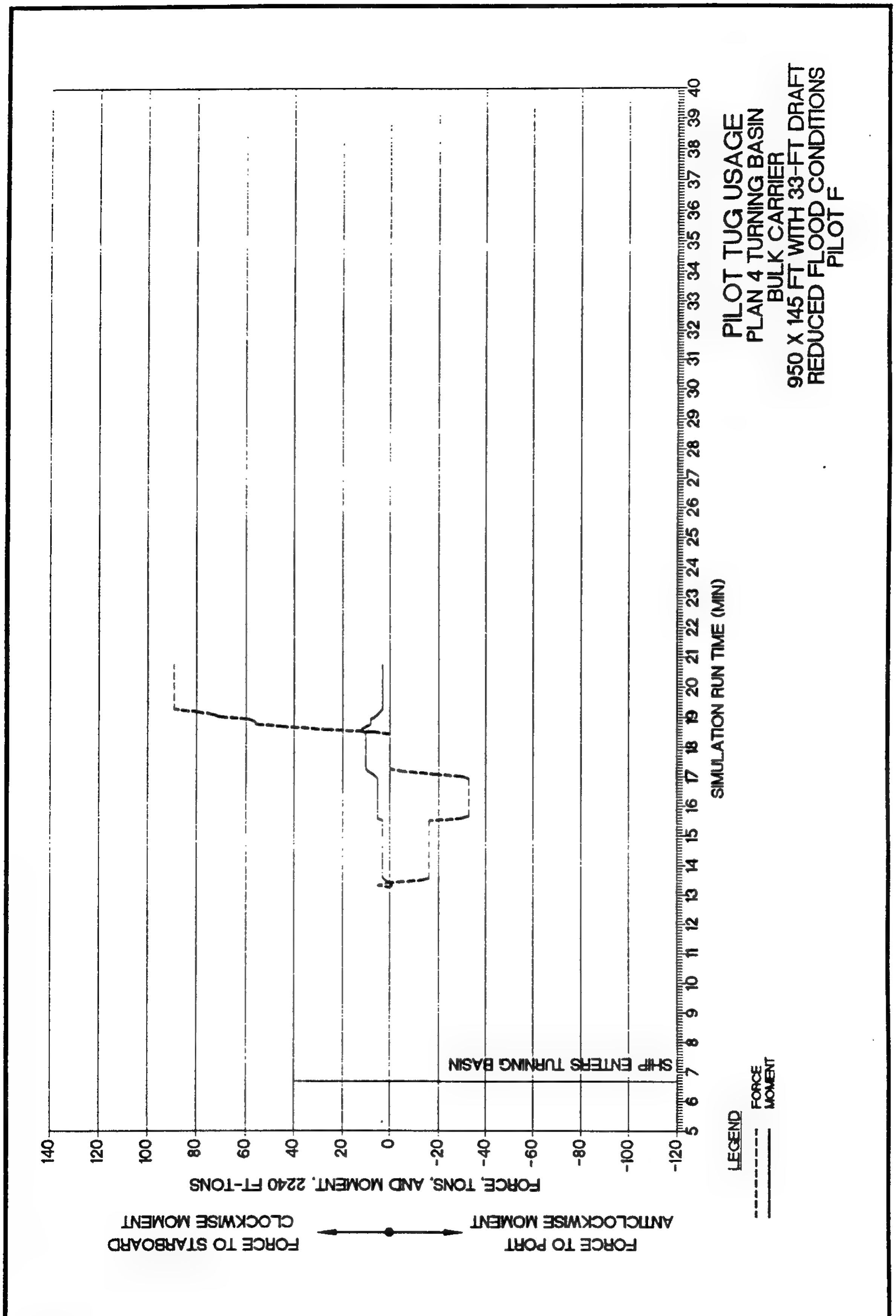
PILOT TUG USAGE
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT E, RUN 1



LITTLE SAND ISLAND
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT E, RUN 2


PILOT TUG USAGE
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT E, RUN 2
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
SHIP ENTERS TURNING BASIN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
LEGEND
FORCE
MOMENT

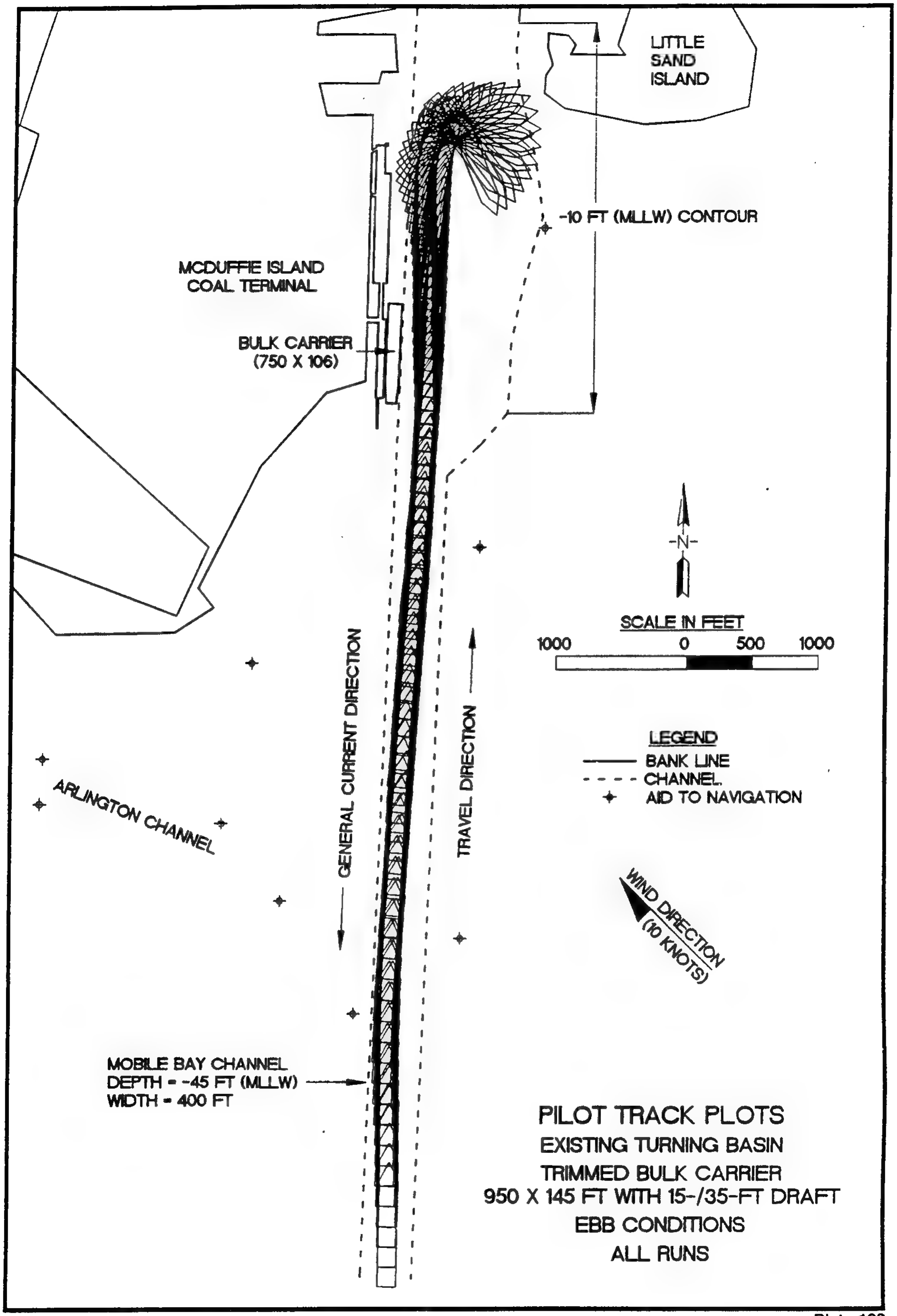

LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT F



PILOT TUG USAGE
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
PILOT F
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE TO STARBOARD
CLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
FORCE
MOMENT

Plate 128

Composite Trackplots


LITTLE SAND ISLAND
-10 FT (MLLW) CONTOUR
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
N
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
EXISTING TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
EBB CONDITIONS
ALL RUNS

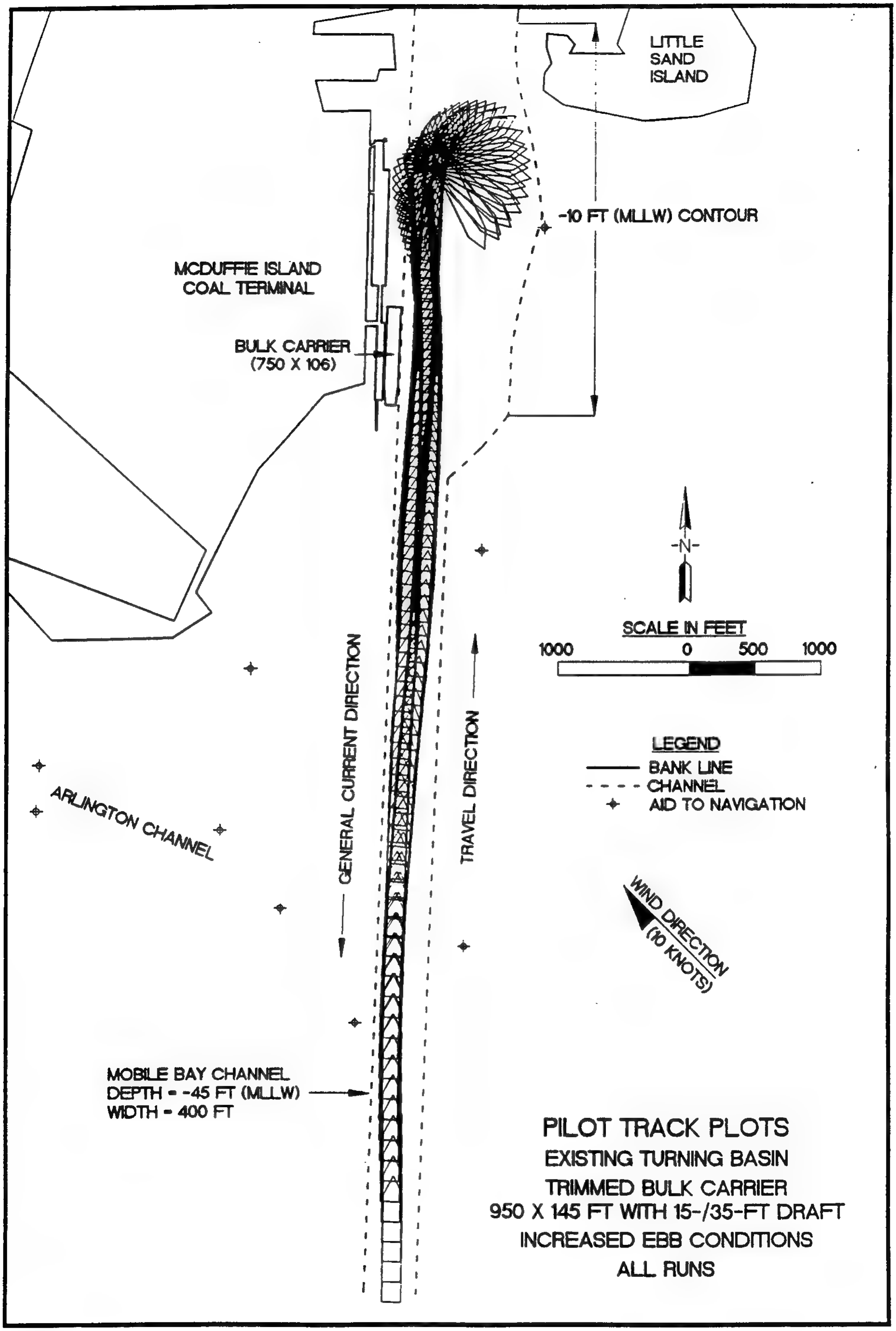
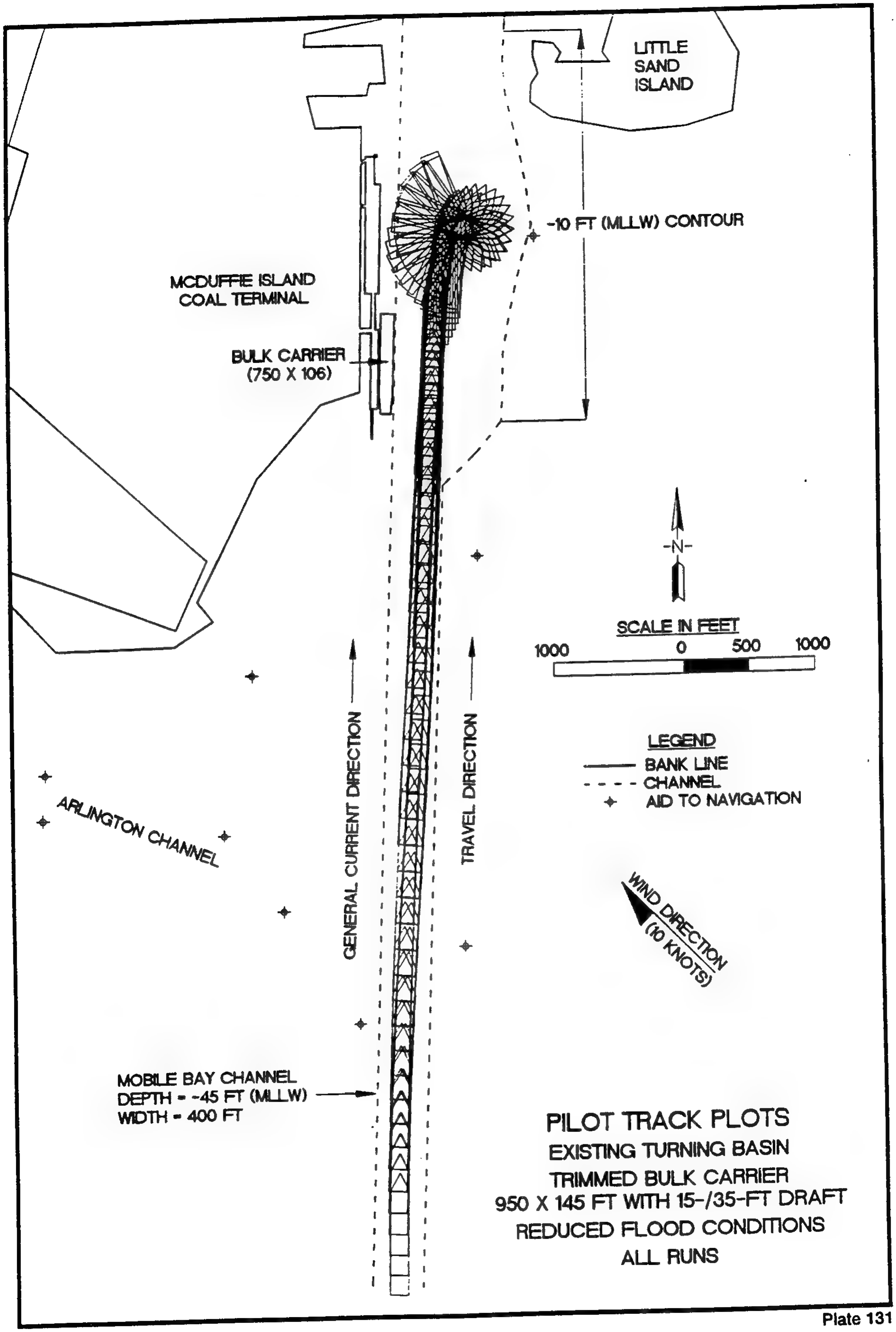
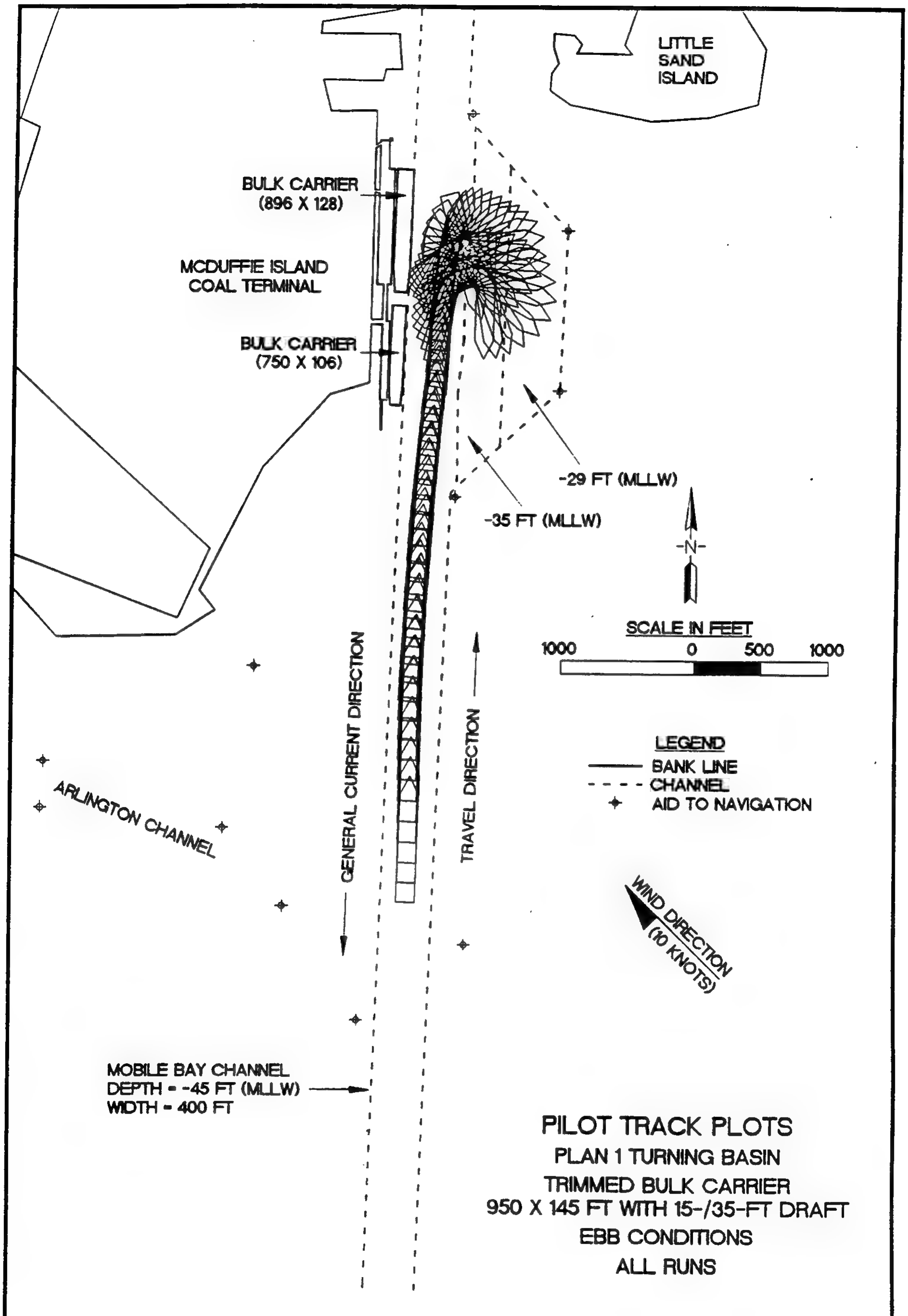

LITTLE SAND ISLAND
-10 FT (MLLW) CONTOUR
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
EXISTING TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
ALL RUNS

Plate 130

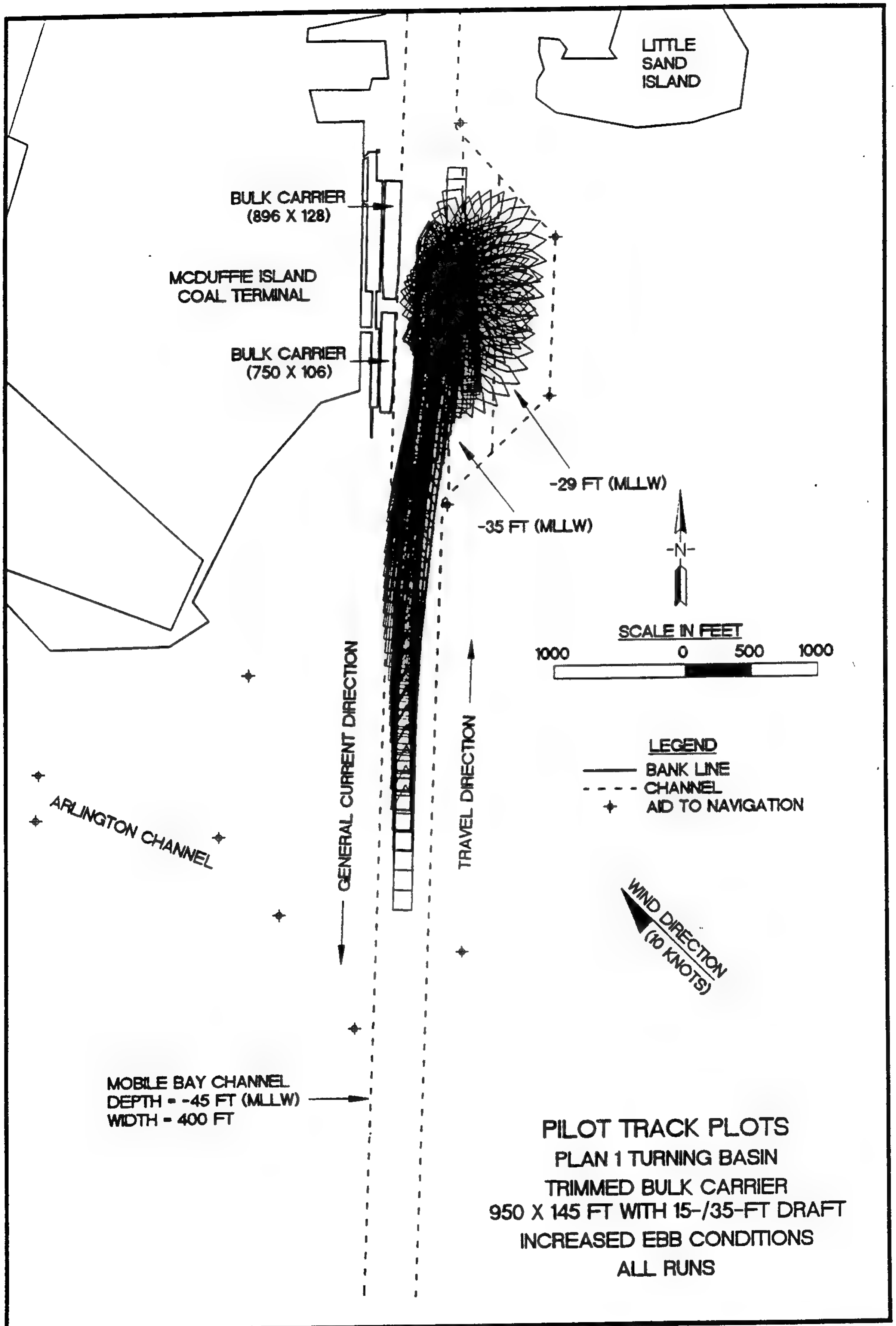


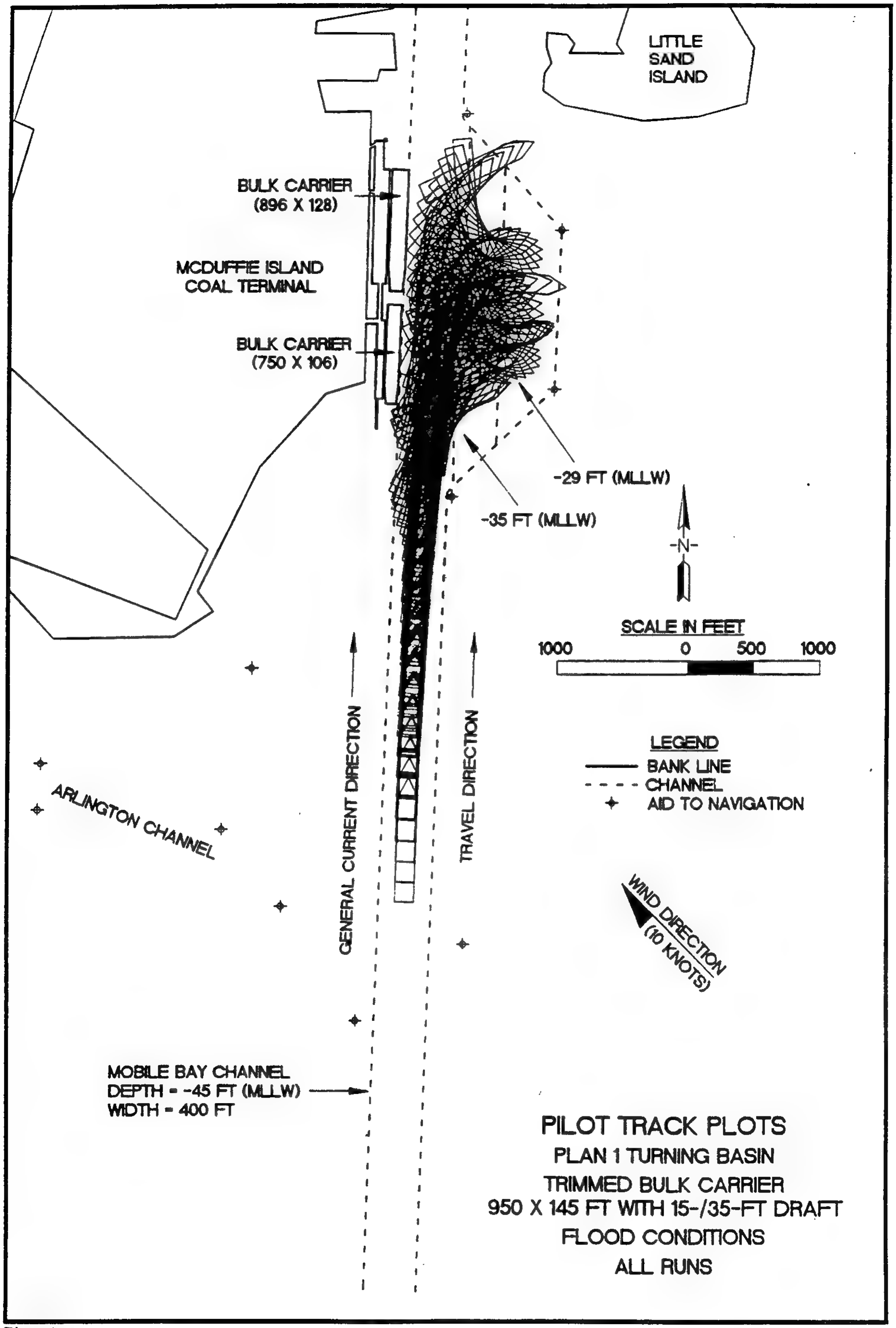
PILOT TRACK PLOTS
EXISTING TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
REDUCED FLOOD CONDITIONS
ALL RUNS



LITTLE SAND ISLAND
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-29 FT (MLLW)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
EBB CONDITIONS
ALL RUNS

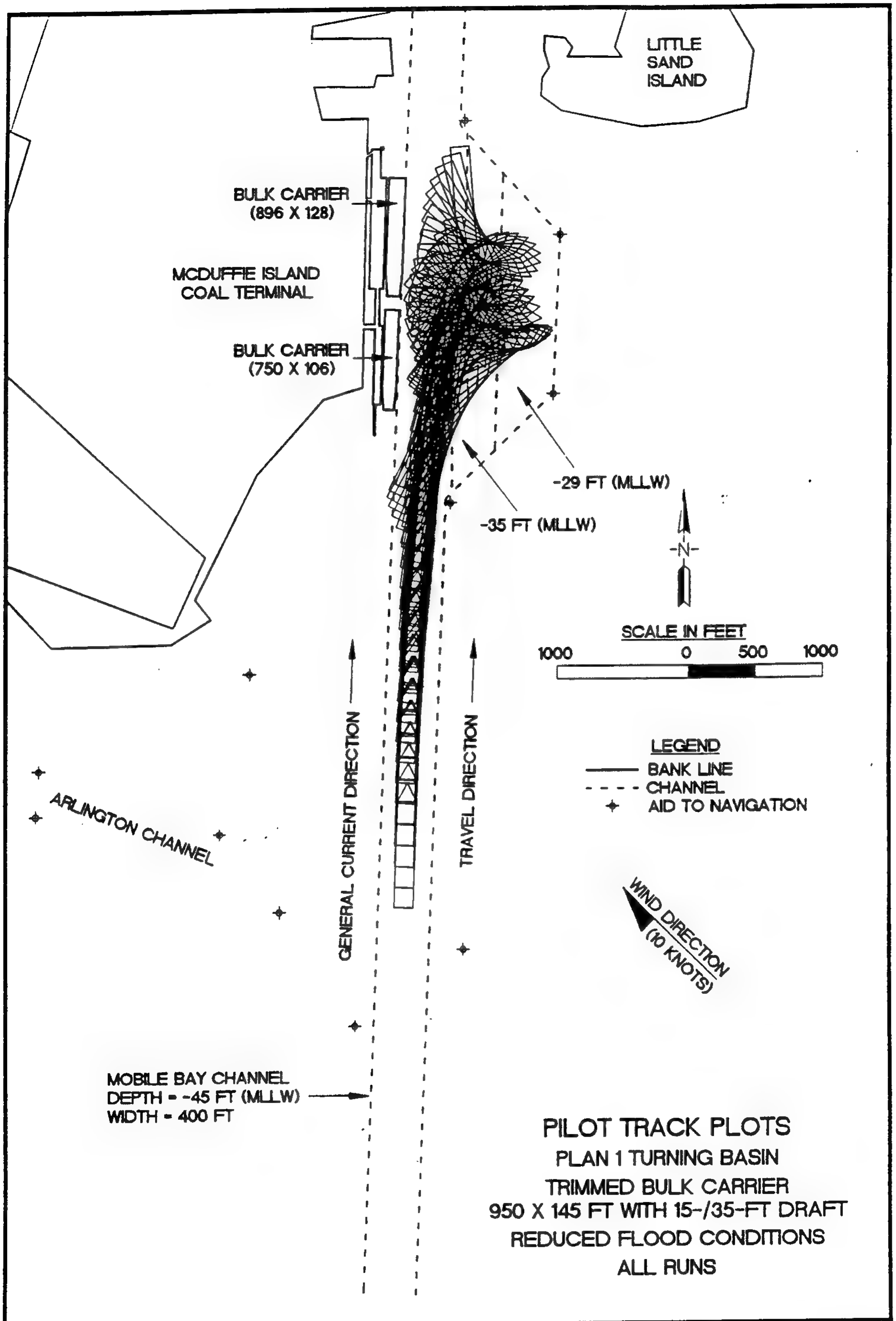
Plate 132

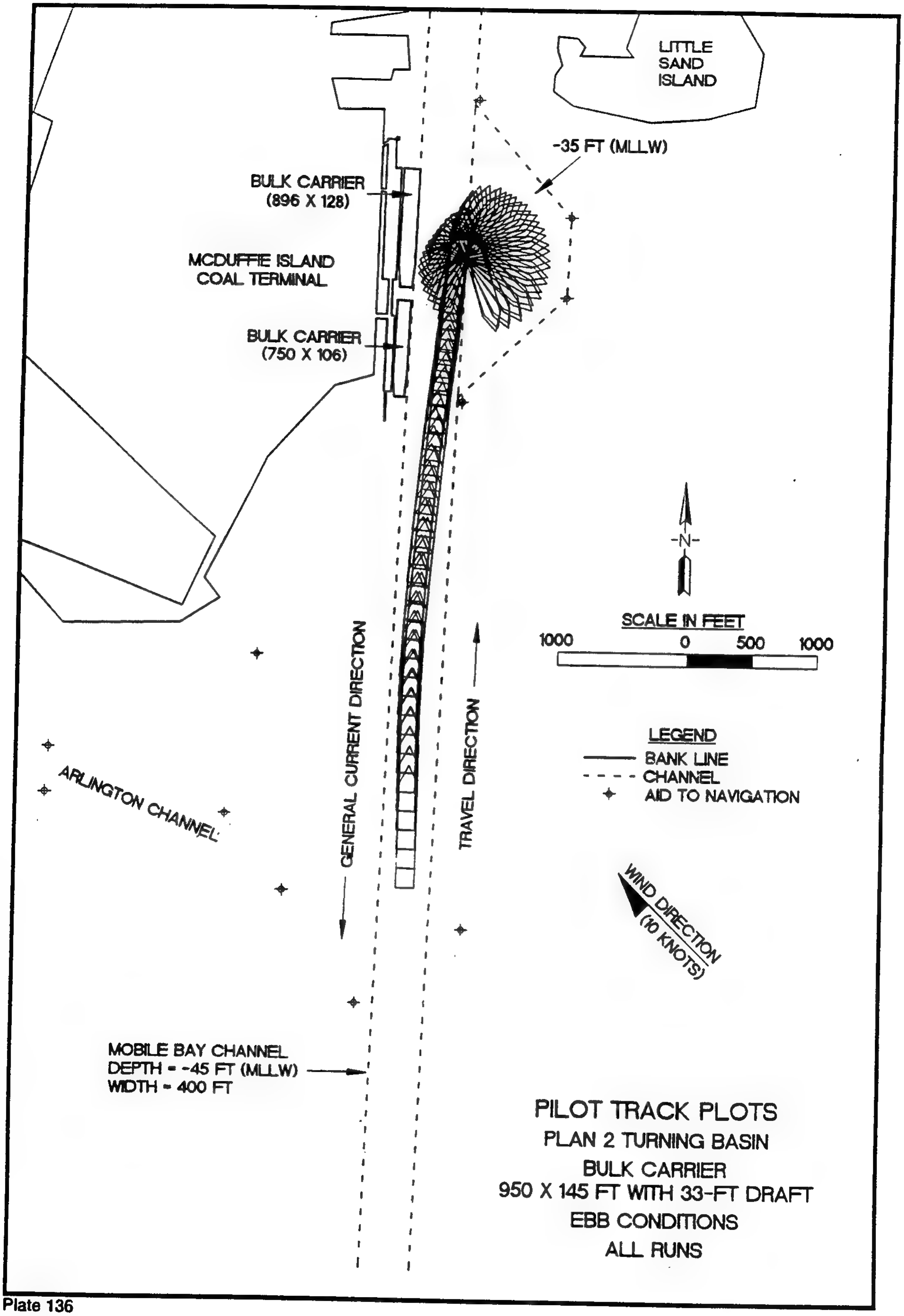

LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-29 FT (MLLW)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
INCREASED EBB CONDITIONS
ALL RUNS



LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-29 FT (MLLW)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
FLOOD CONDITIONS
ALL RUNS

Plate 134


LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-29 FT (MLLW)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 1 TURNING BASIN
TRIMMED BULK CARRIER
950 X 145 FT WITH 15-/35-FT DRAFT
REDUCED FLOOD CONDITIONS
ALL RUNS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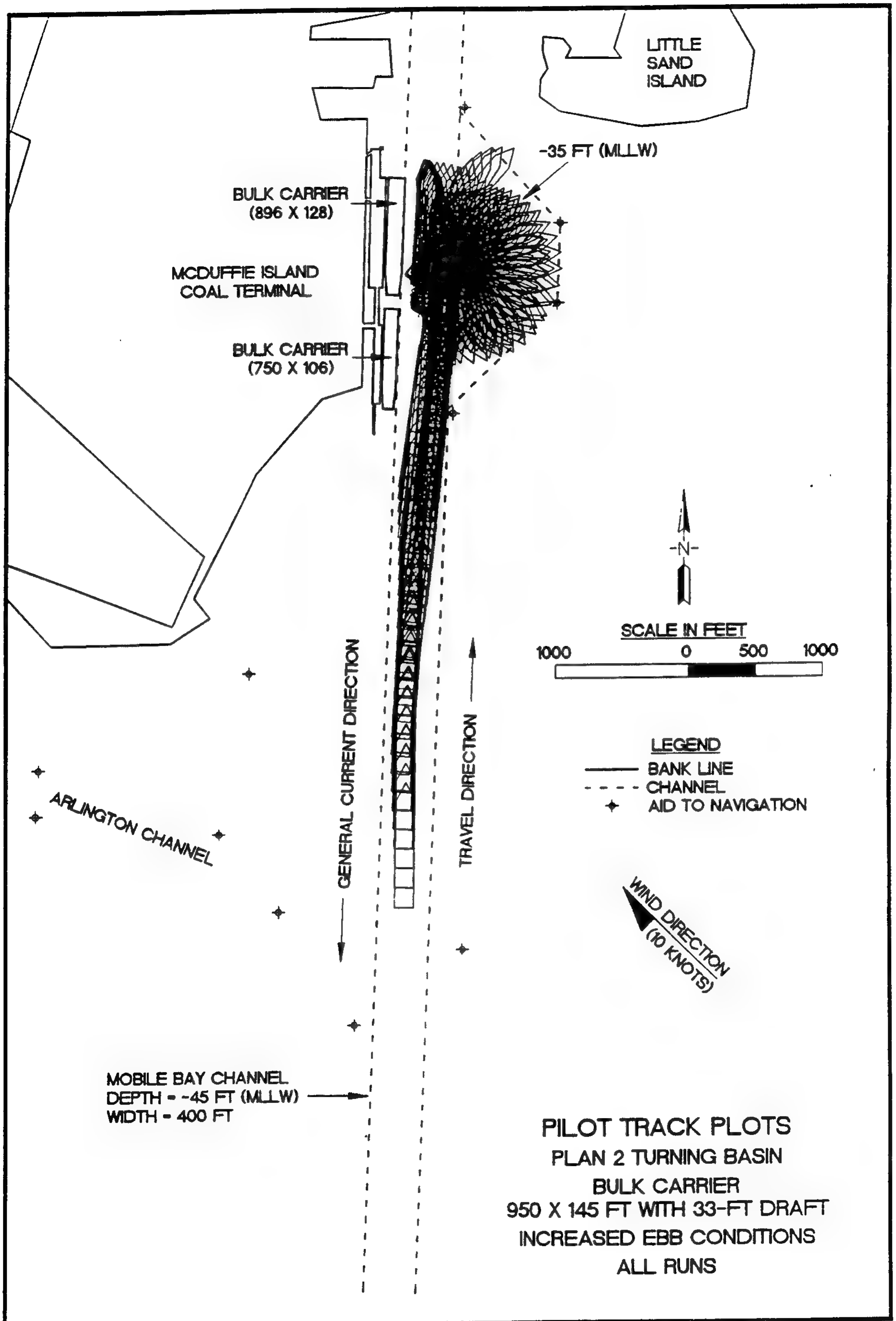
SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
EBB CONDITIONS
ALL RUNS



PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
ALL RUNS

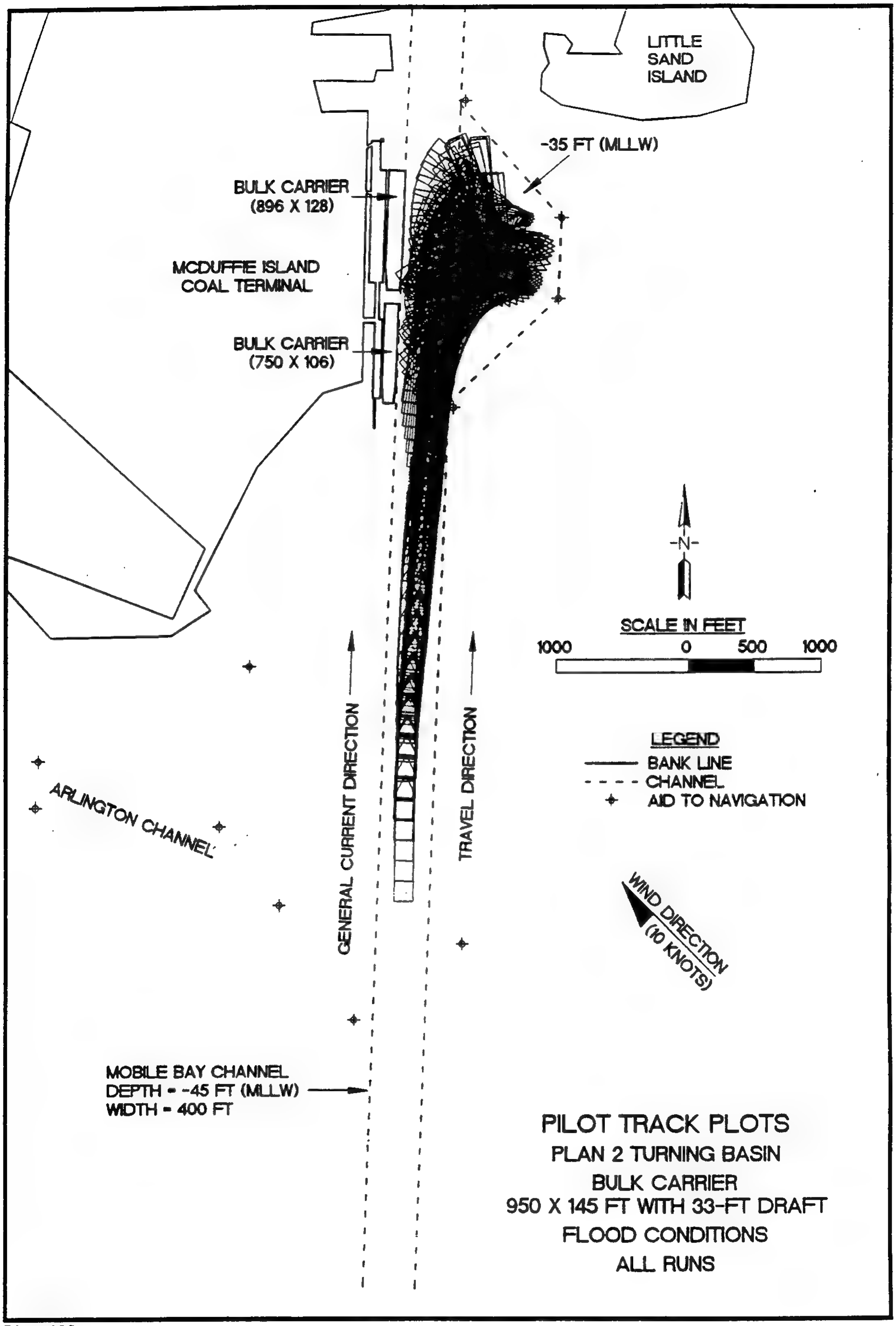
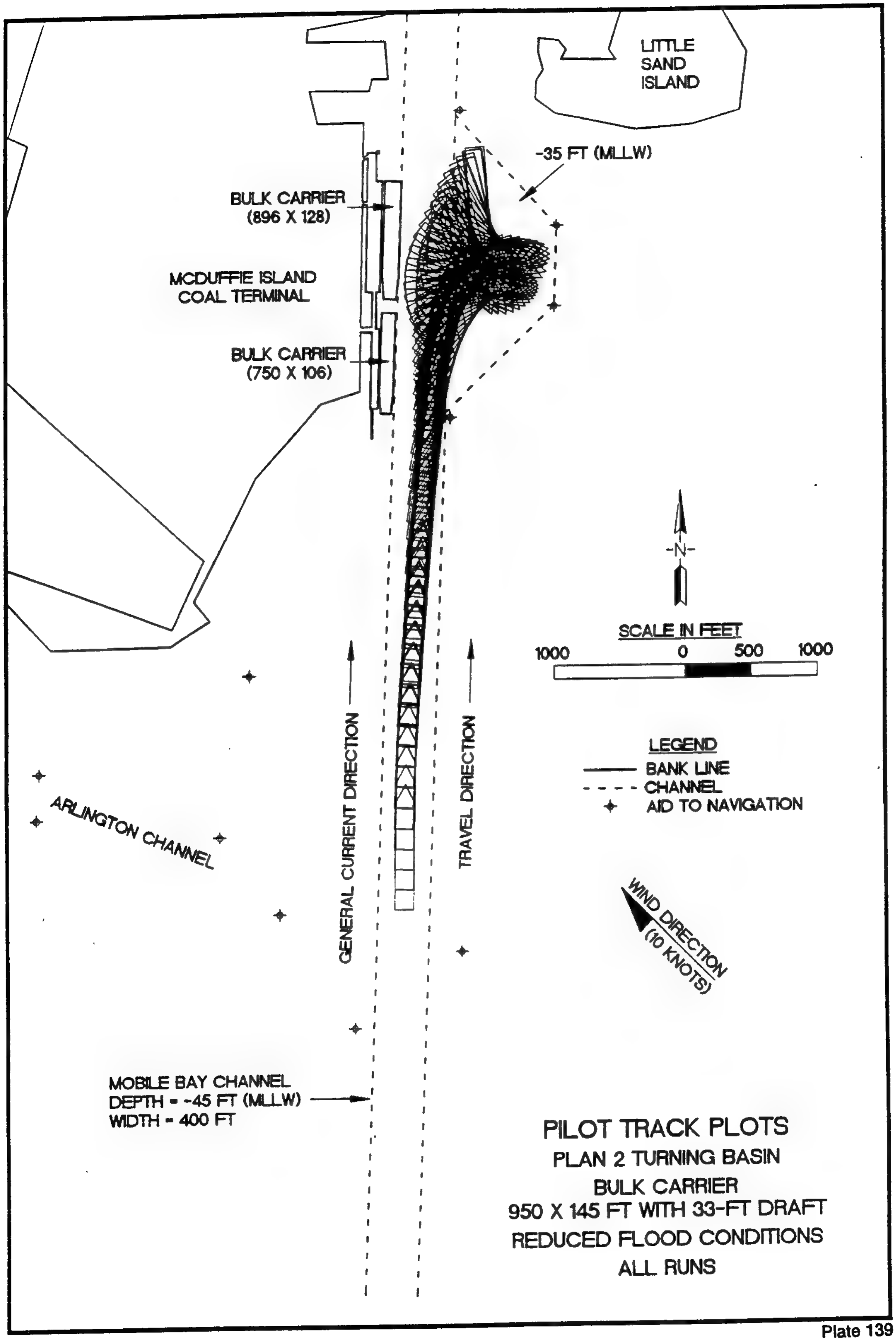
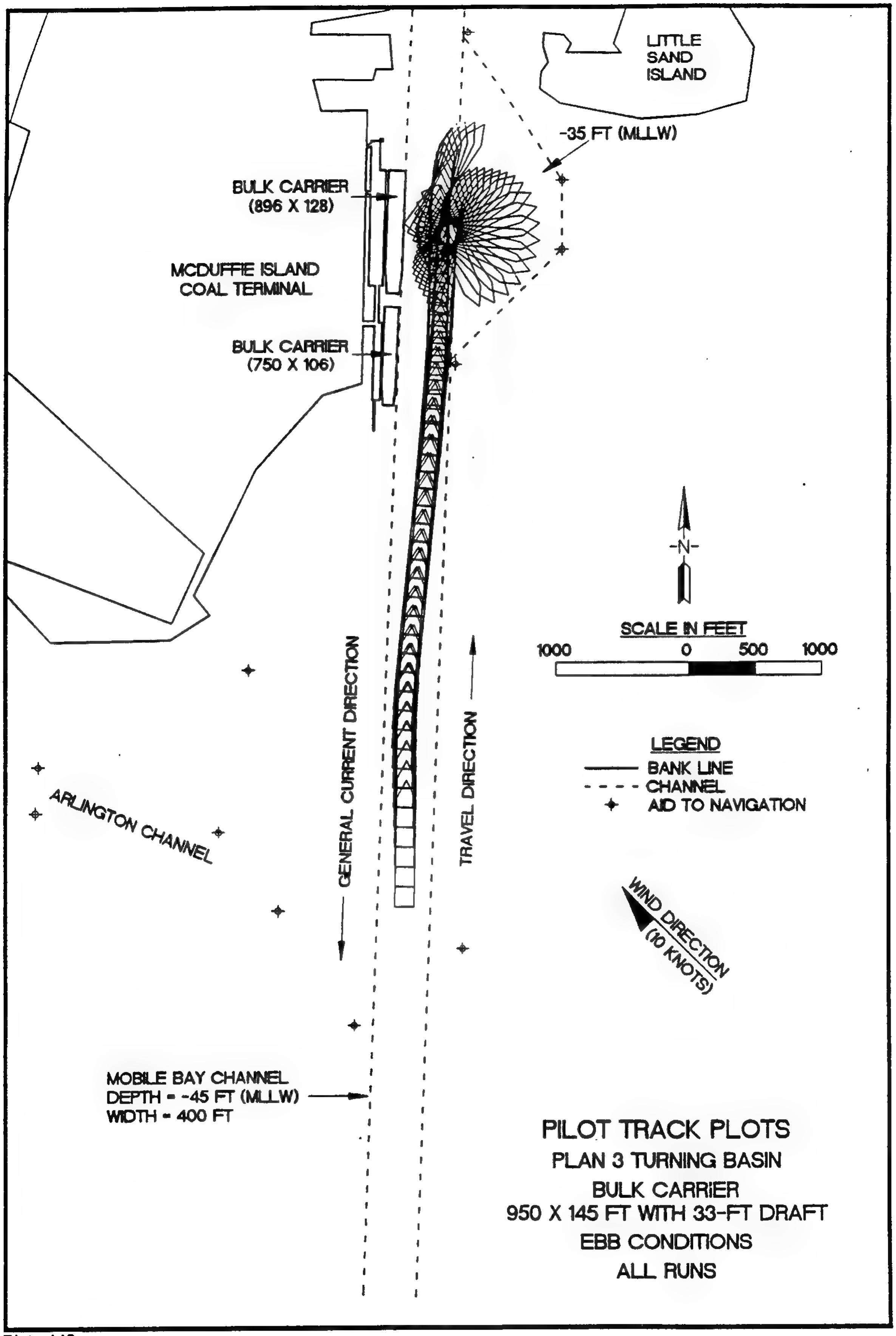

LITTLE SAND ISLAND
-35 FT (MLLW)
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
ALL RUNS

Plate 138


LITTLE
SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000
0
500
1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 2 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
ALL RUNS


LITTLE
SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
EBB CONDITIONS
ALL RUNS

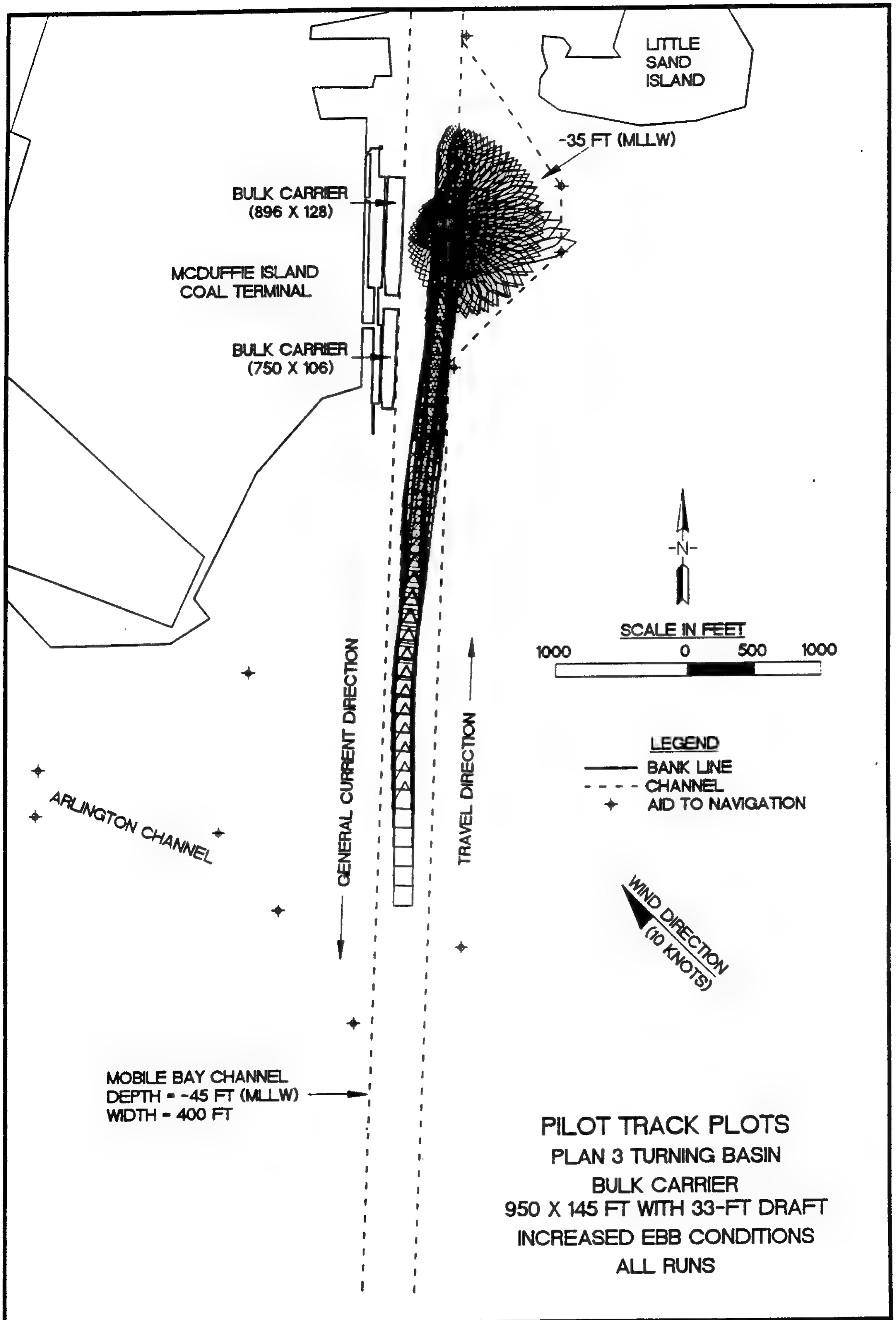
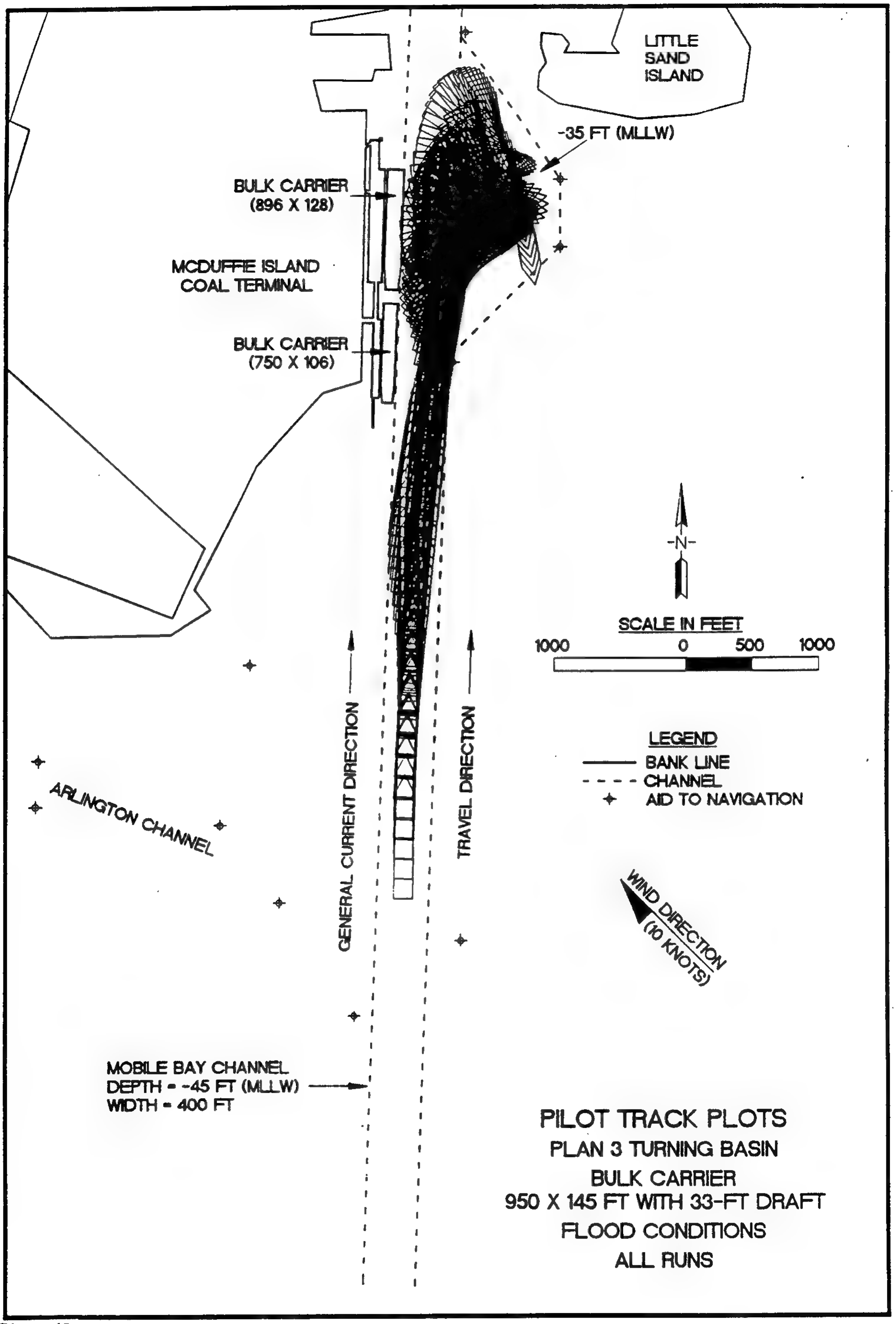
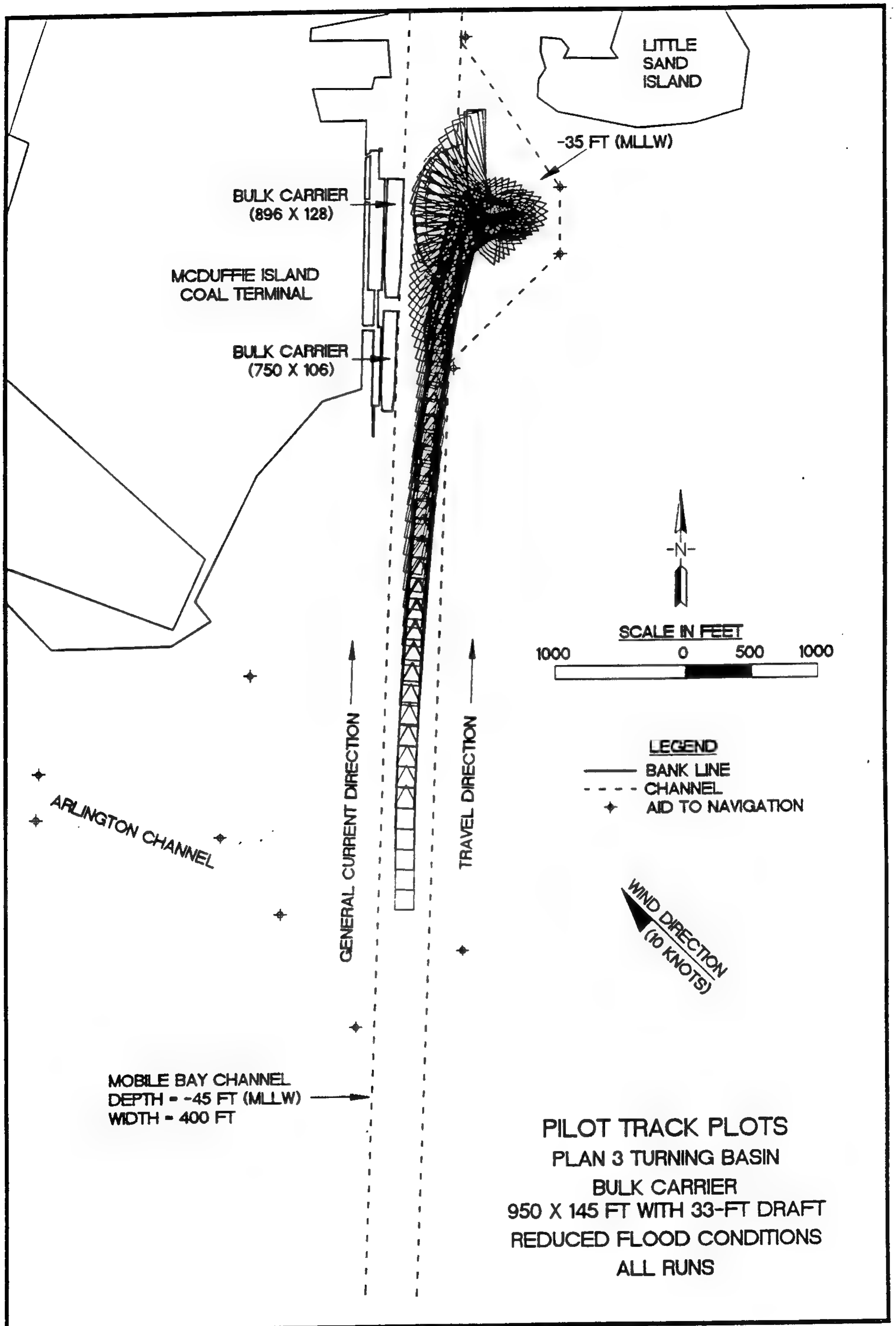
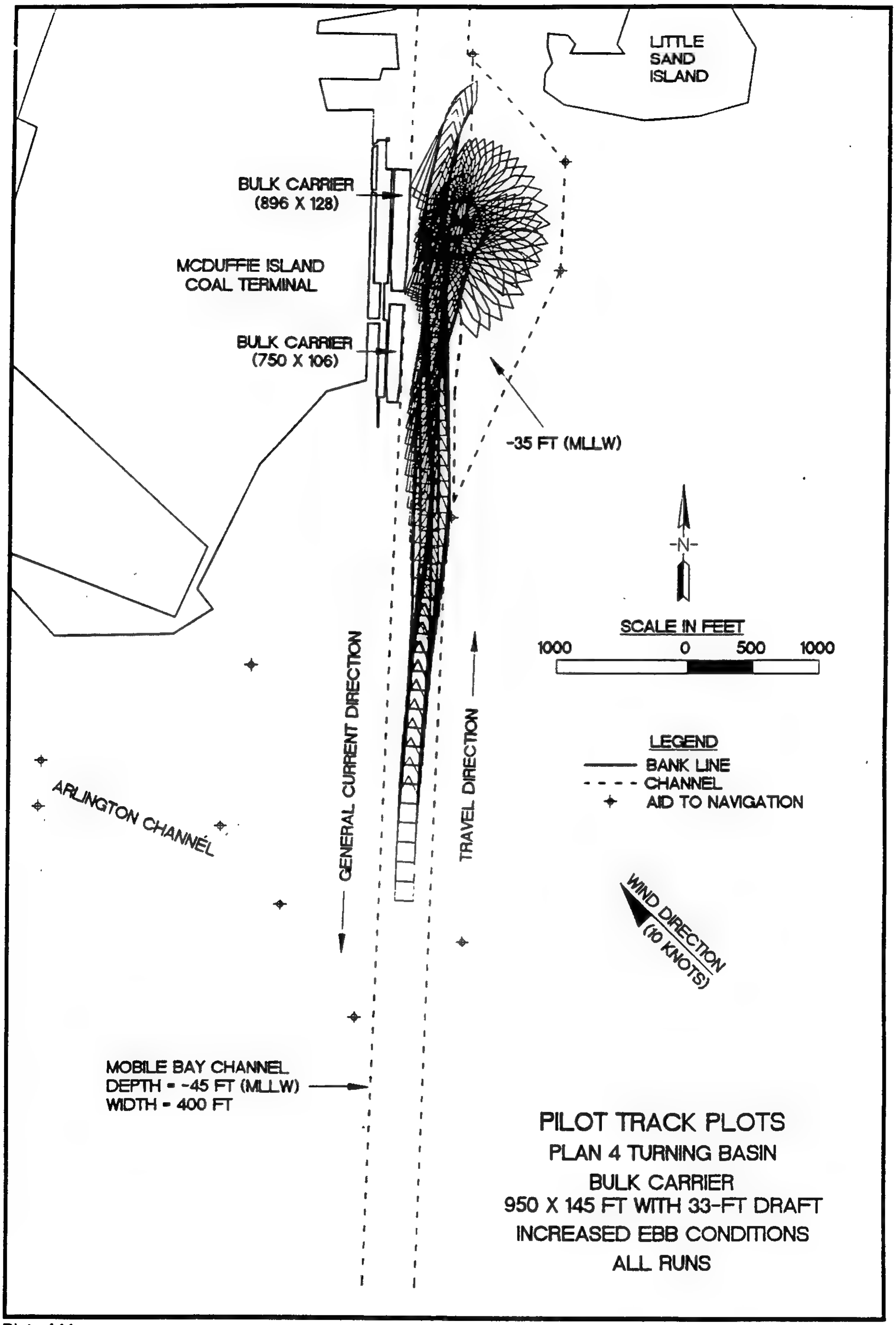
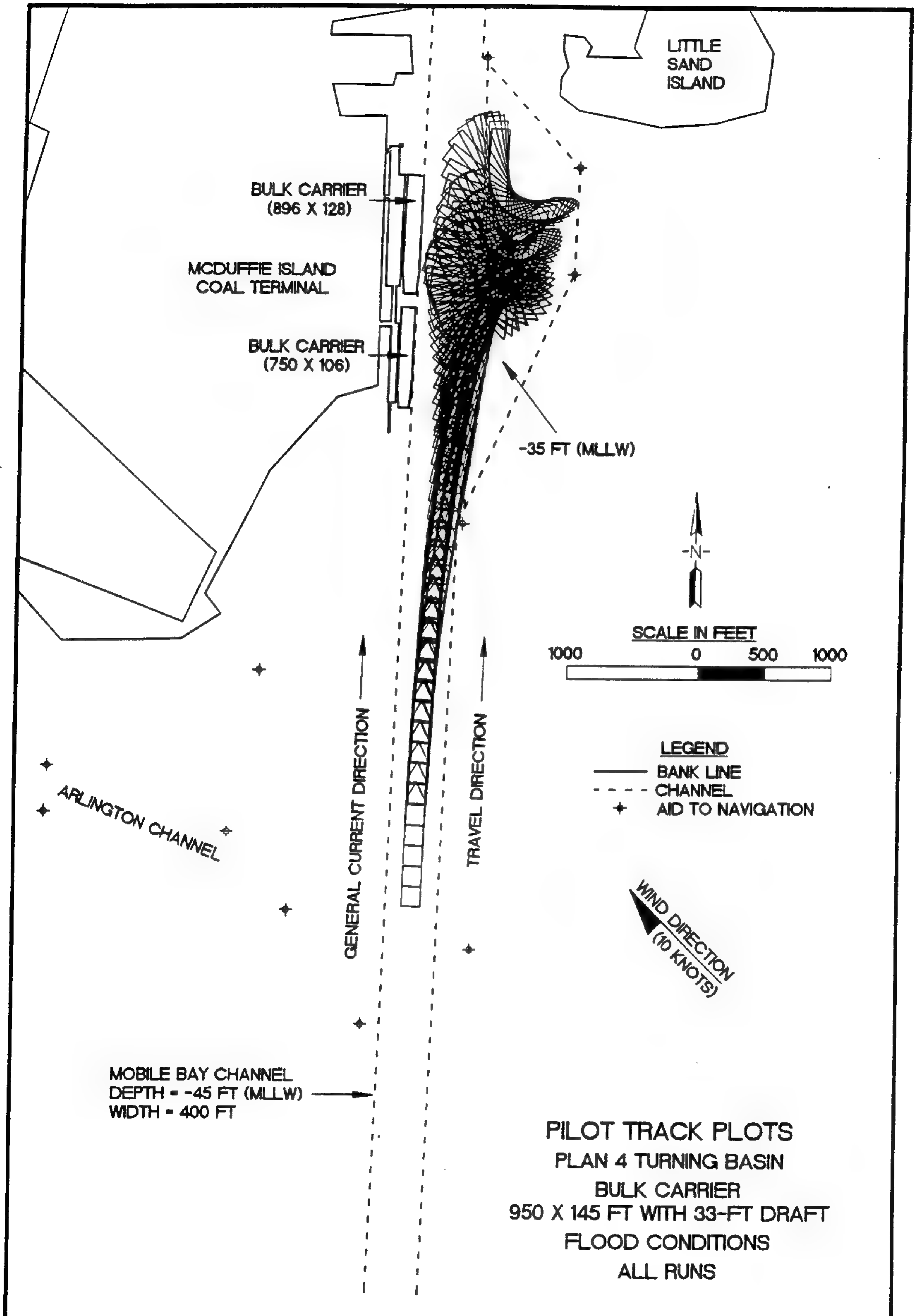

LITTLE
SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
N
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
ALL RUNS

Plate 141


LITTLE
SAND
ISLAND
-35 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
ALL RUNS


LITTLE SAND ISLAND
-35 FT (MLLW)
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 3 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
ALL RUNS


LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
INCREASED EBB CONDITIONS
ALL RUNS


LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
FLOOD CONDITIONS
ALL RUNS

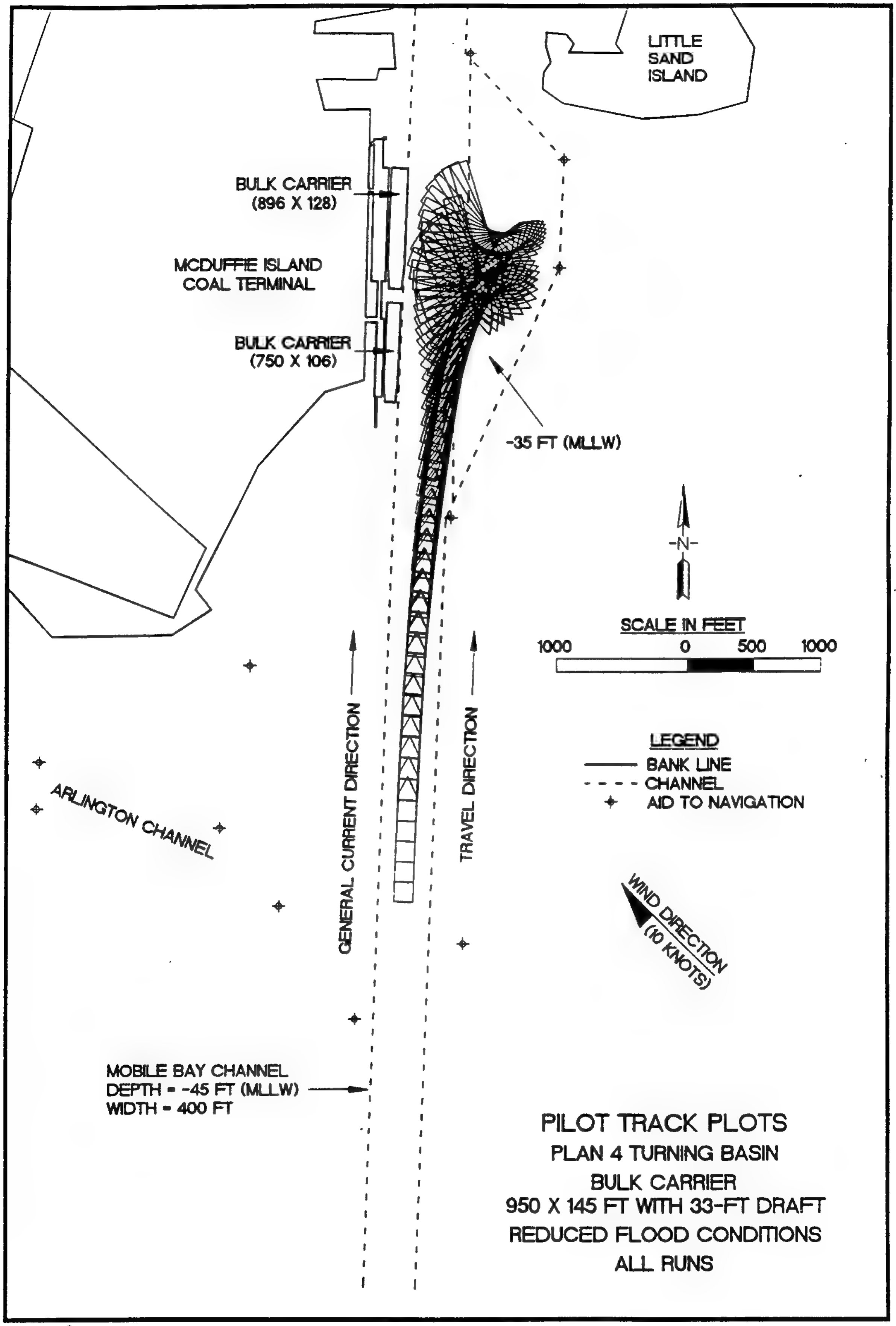
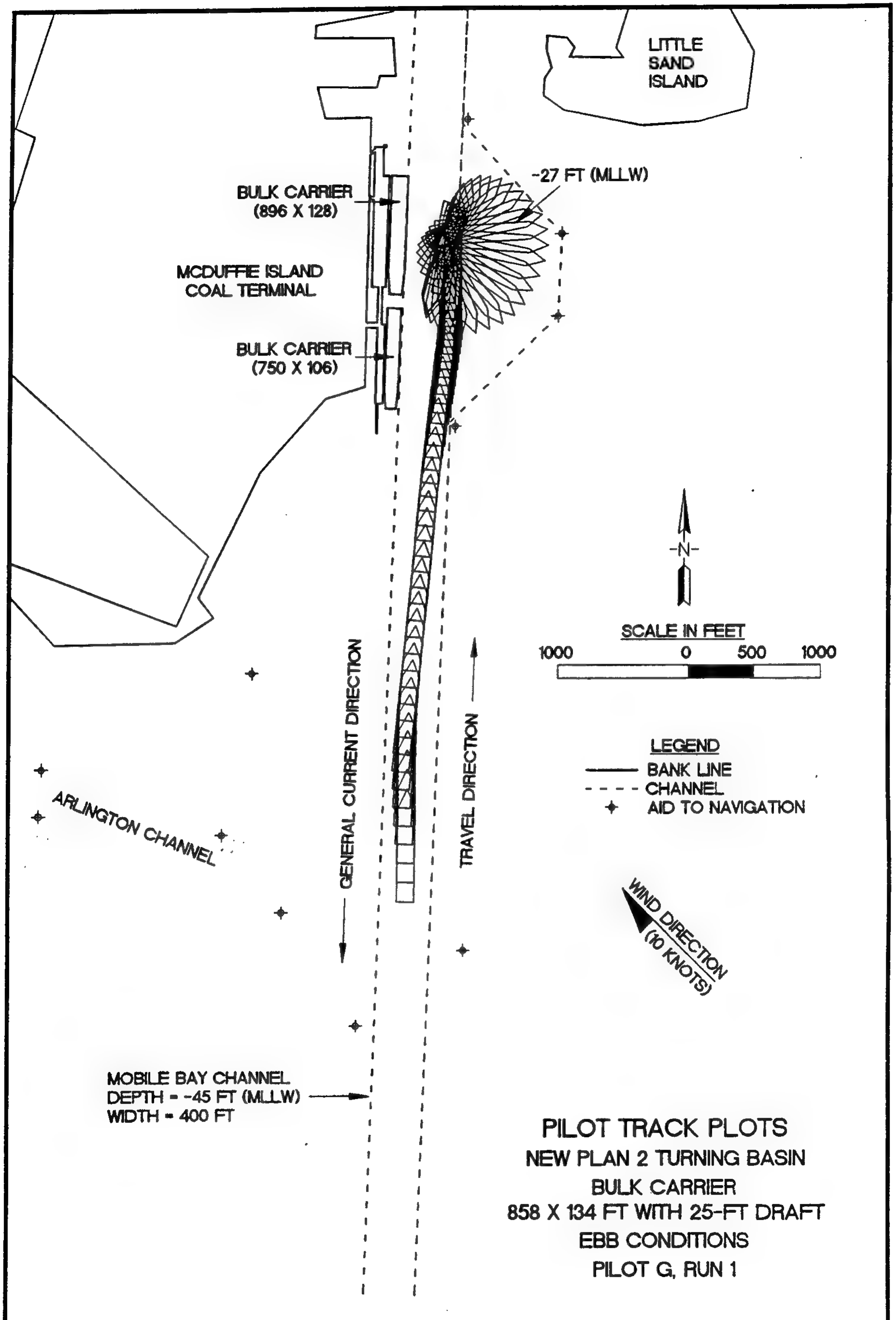
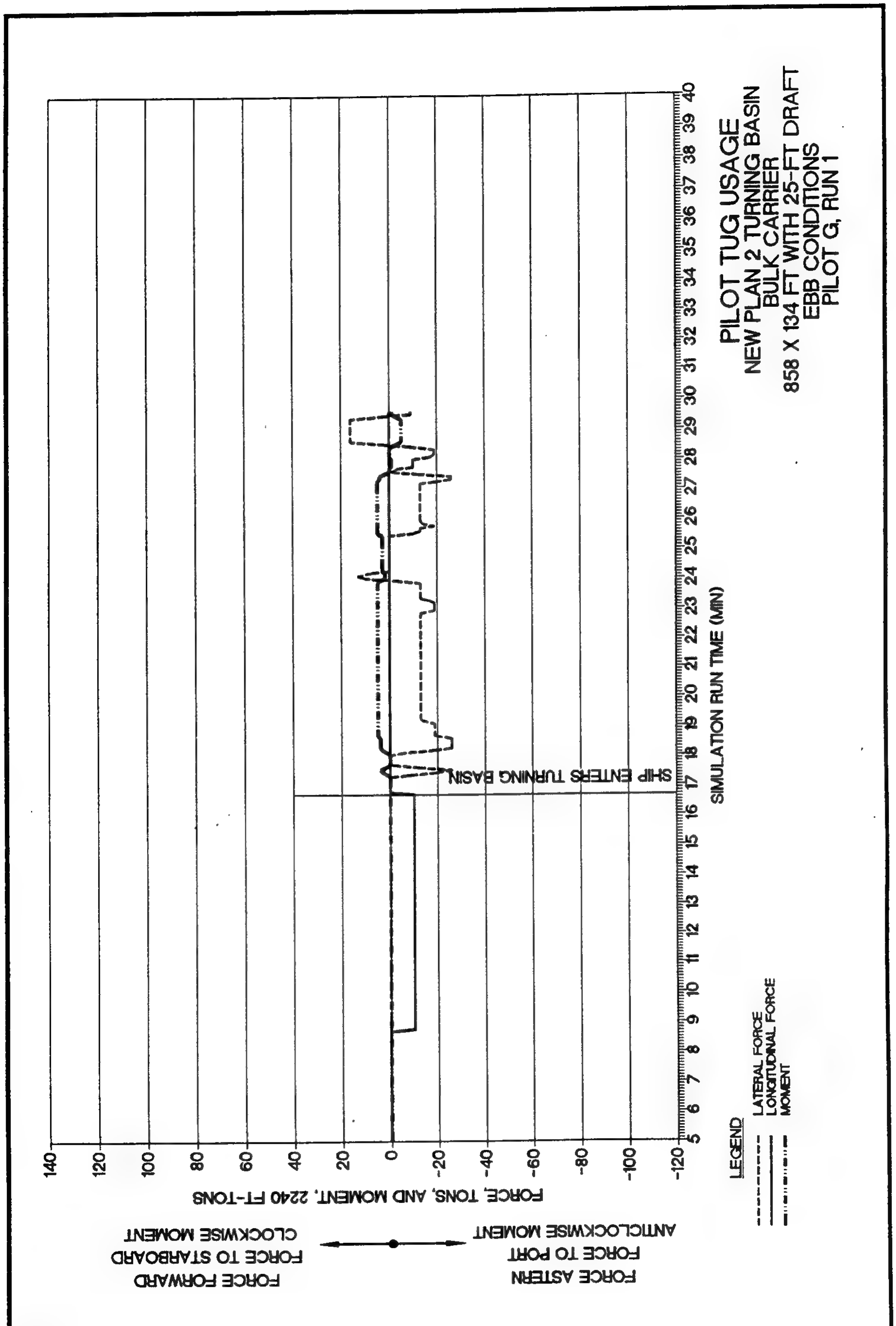

LITTLE
SAND
ISLAND
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-35 FT (MLLW)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
PLAN 4 TURNING BASIN
BULK CARRIER
950 X 145 FT WITH 33-FT DRAFT
REDUCED FLOOD CONDITIONS
ALL RUNS

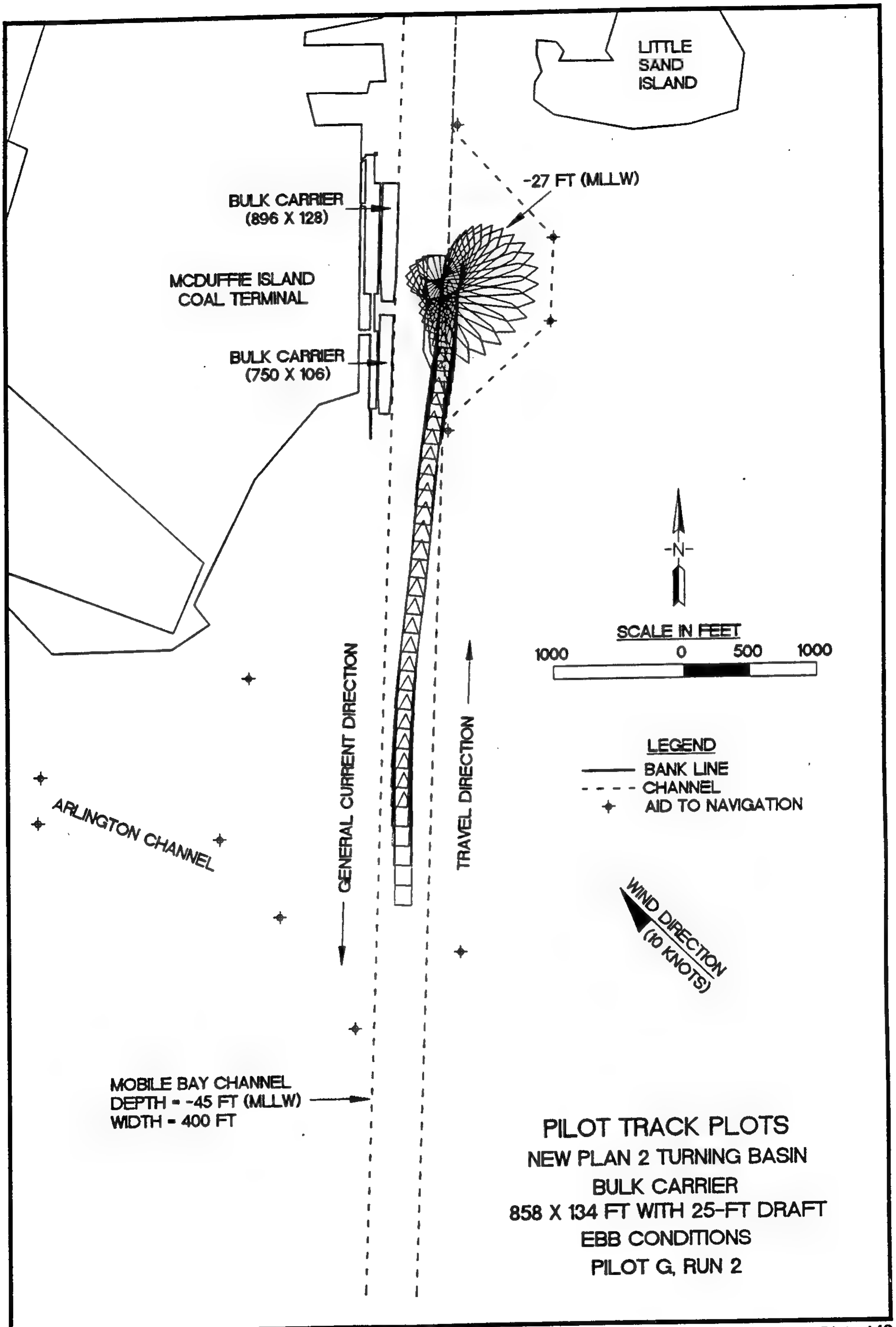
Plate 146

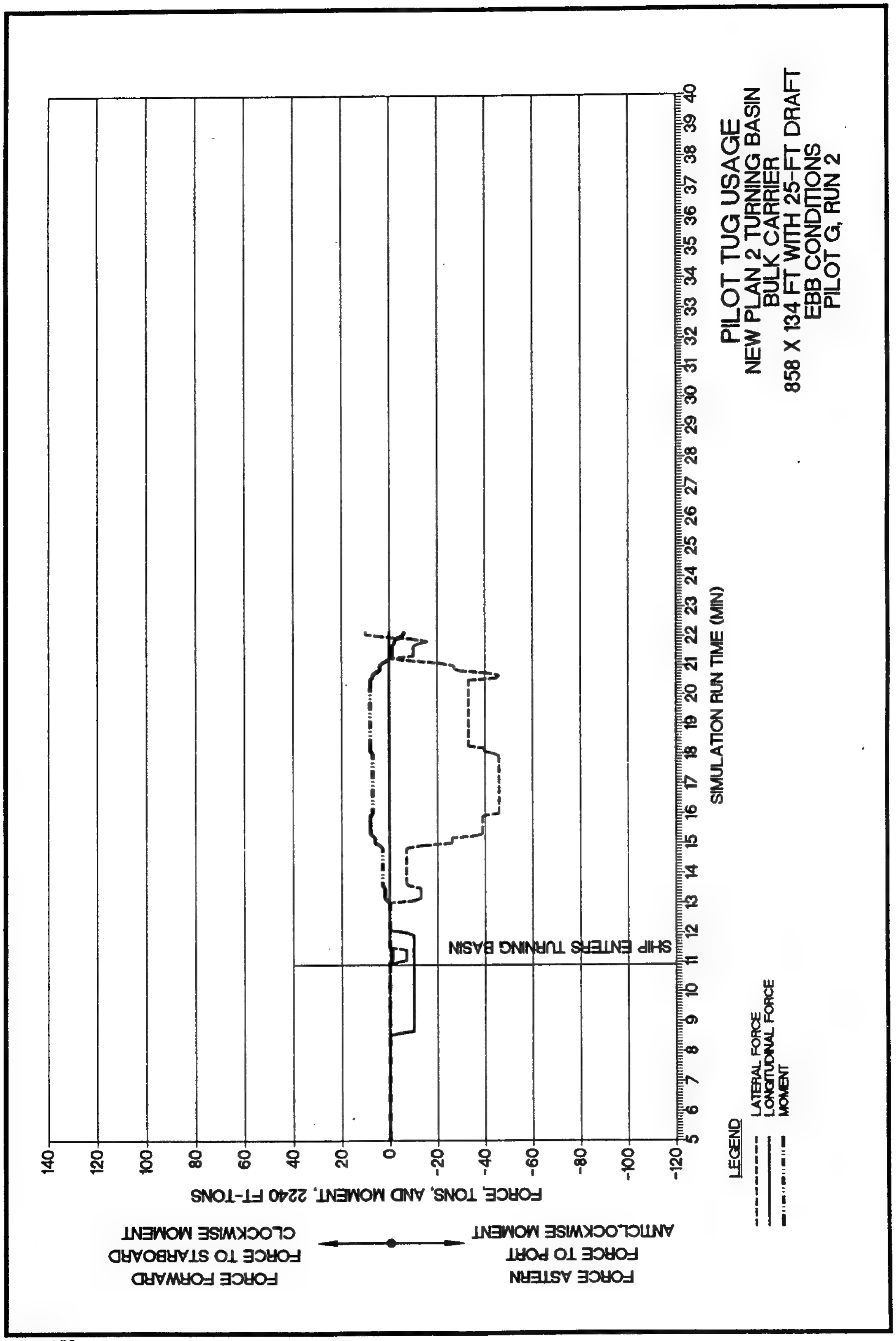
New Plan 2 Results



PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT G, RUN 1


PILOT TUG USAGE
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT G, RUN 1
SHIP ENTERS TURNING BASIN
SIMULATION RUN TIME (MIN)
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
FORCE, TONS, AND MOMENT, 2240 FT-TONS
140 120 100 80 60 40 20 0 -20 -40 -60 -80 -100 -120
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT


LITTLE SAND ISLAND
-27 FT (MLLW)
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
N
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT G, RUN 2


PILOT TUG USAGE
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT G, RUN 2
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
SHIP ENTERS TURNING BASIN
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT
140
120
100
80
60
40
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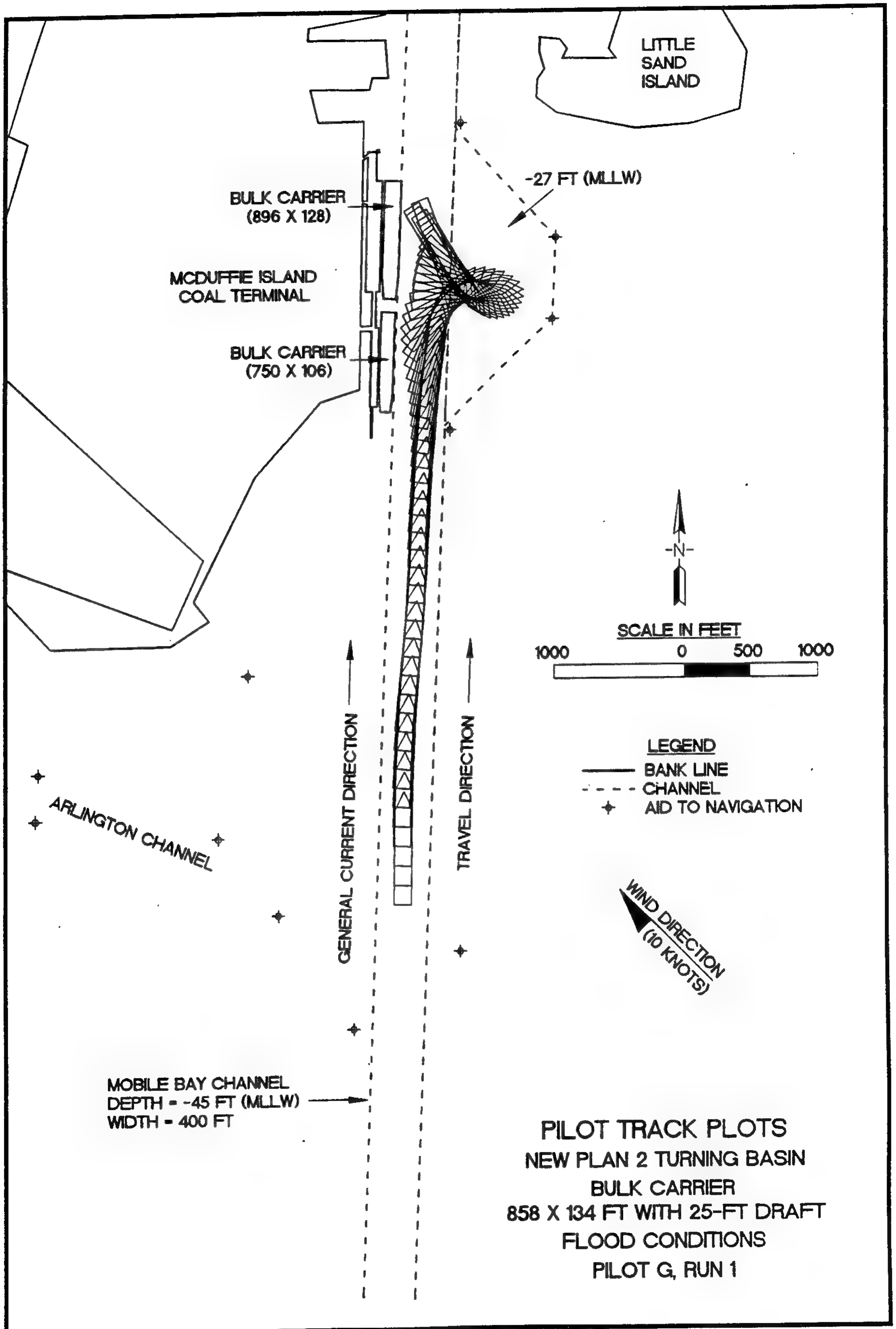
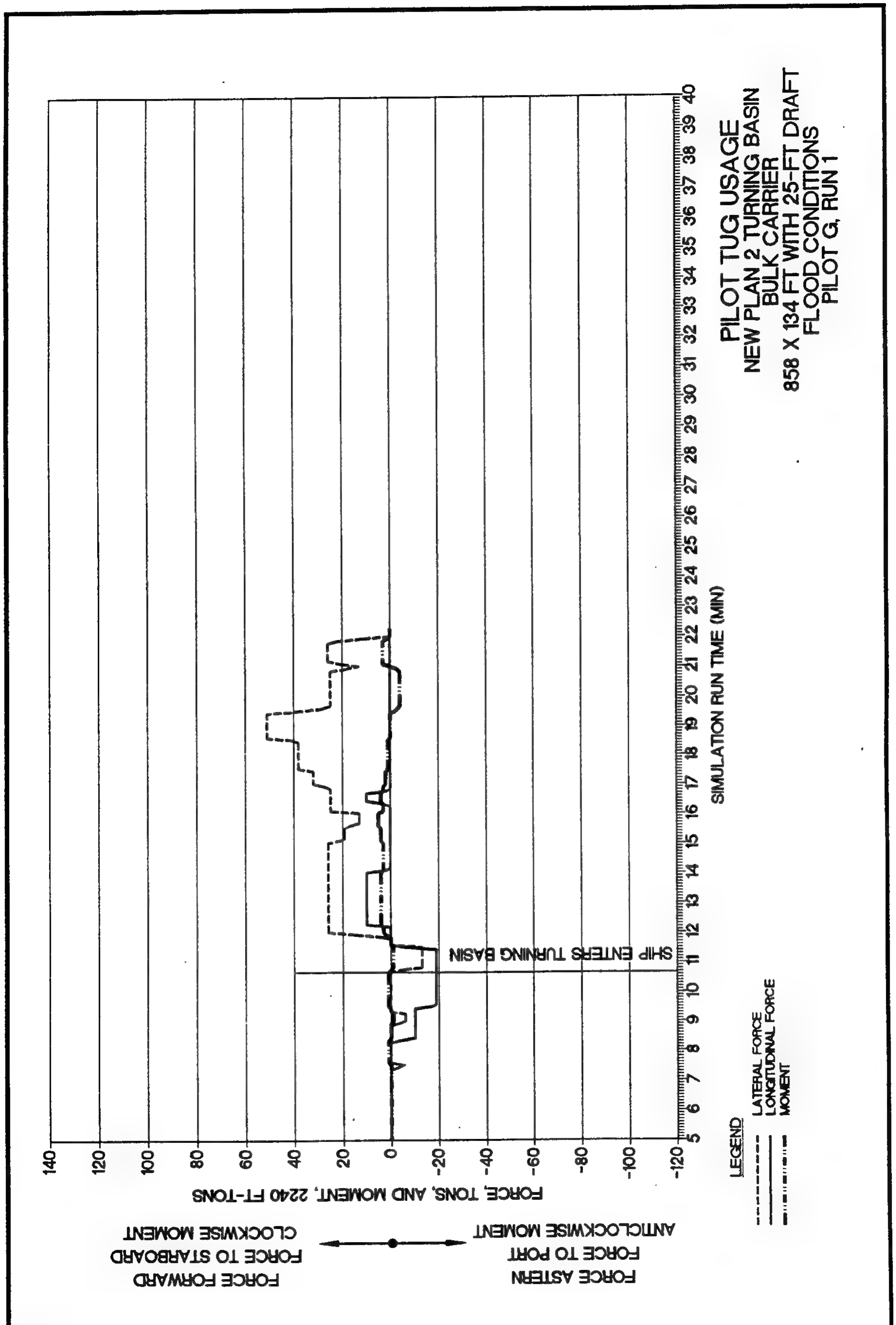
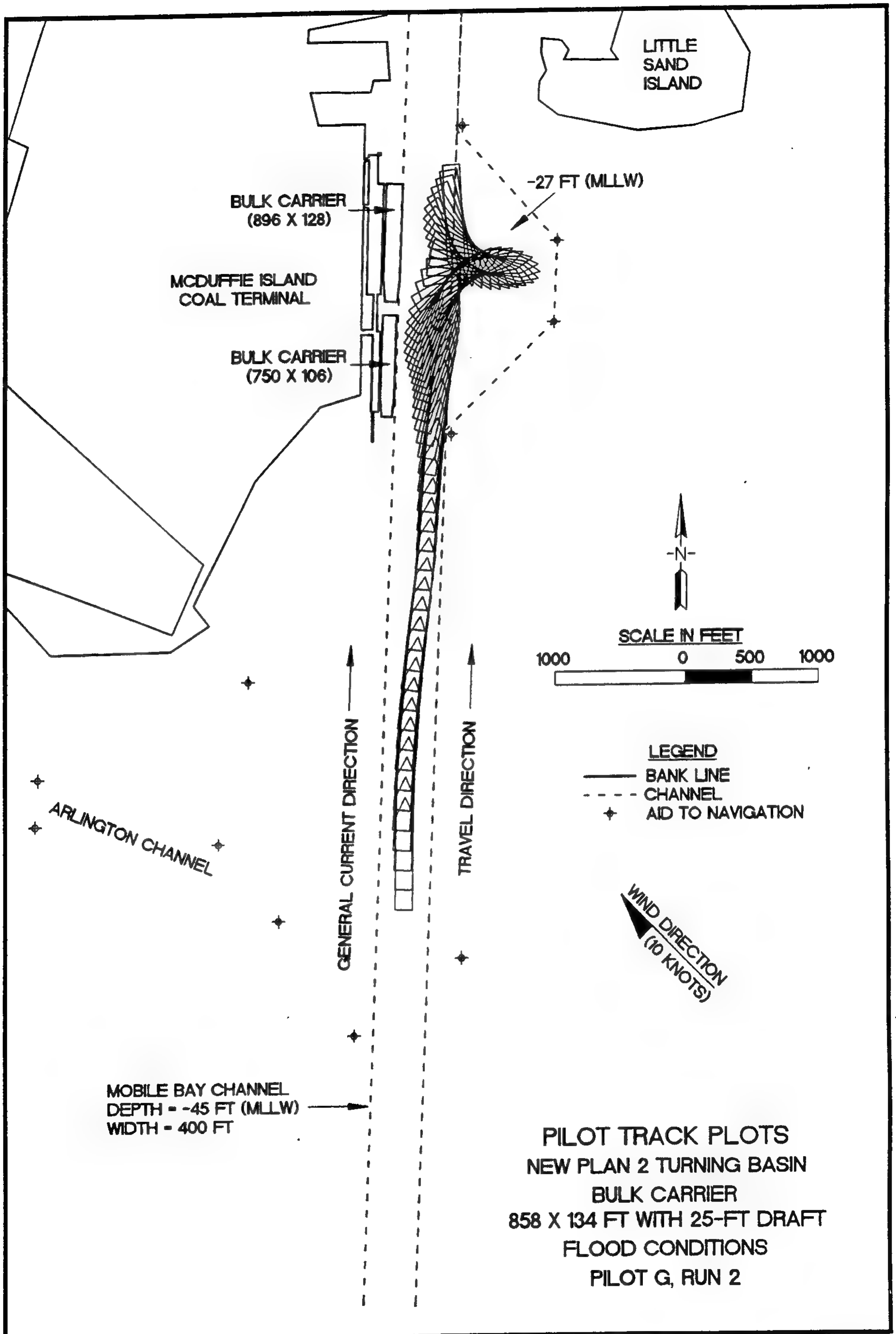
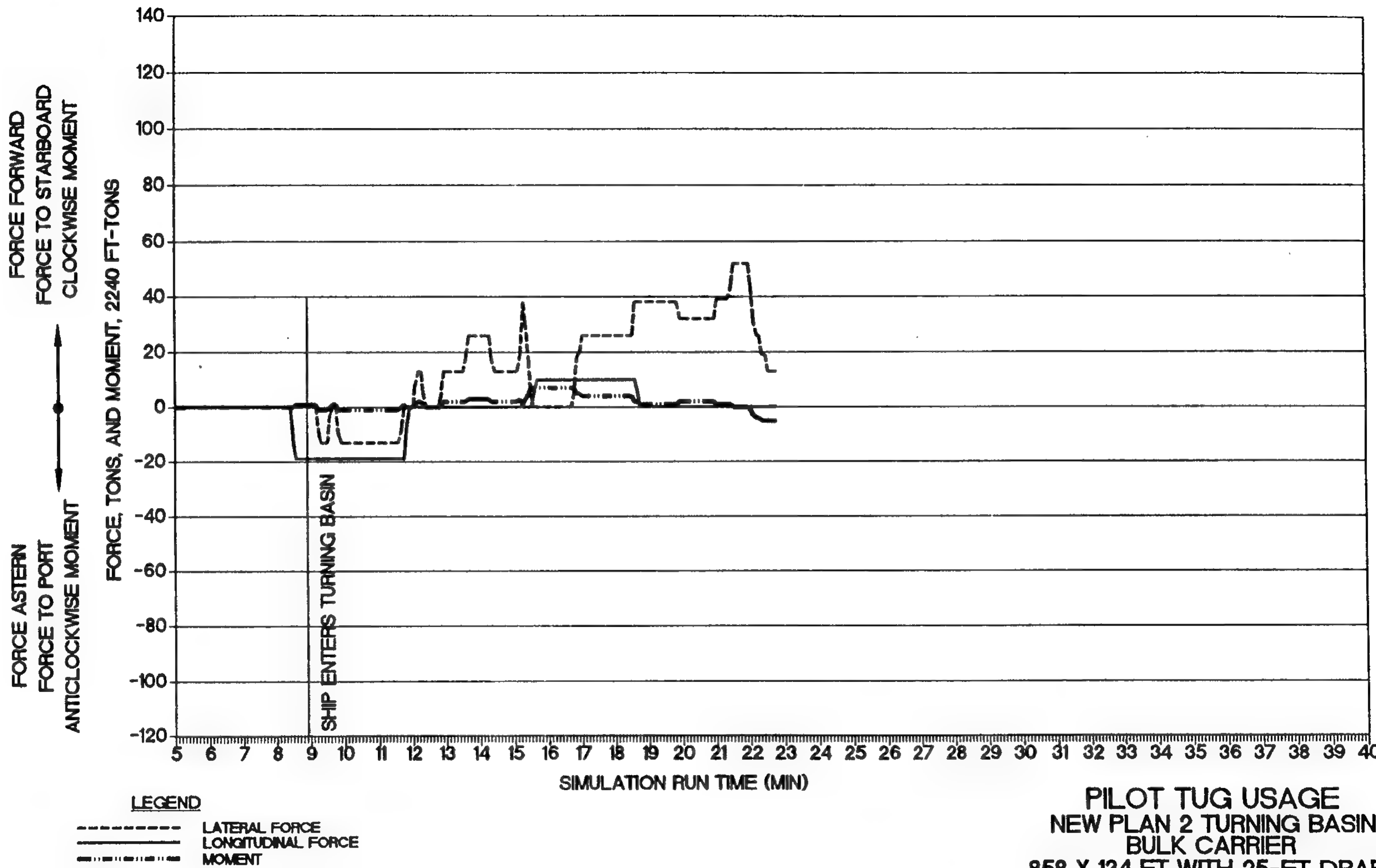
0
-20
-40
-60
-80
-100
-120
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40



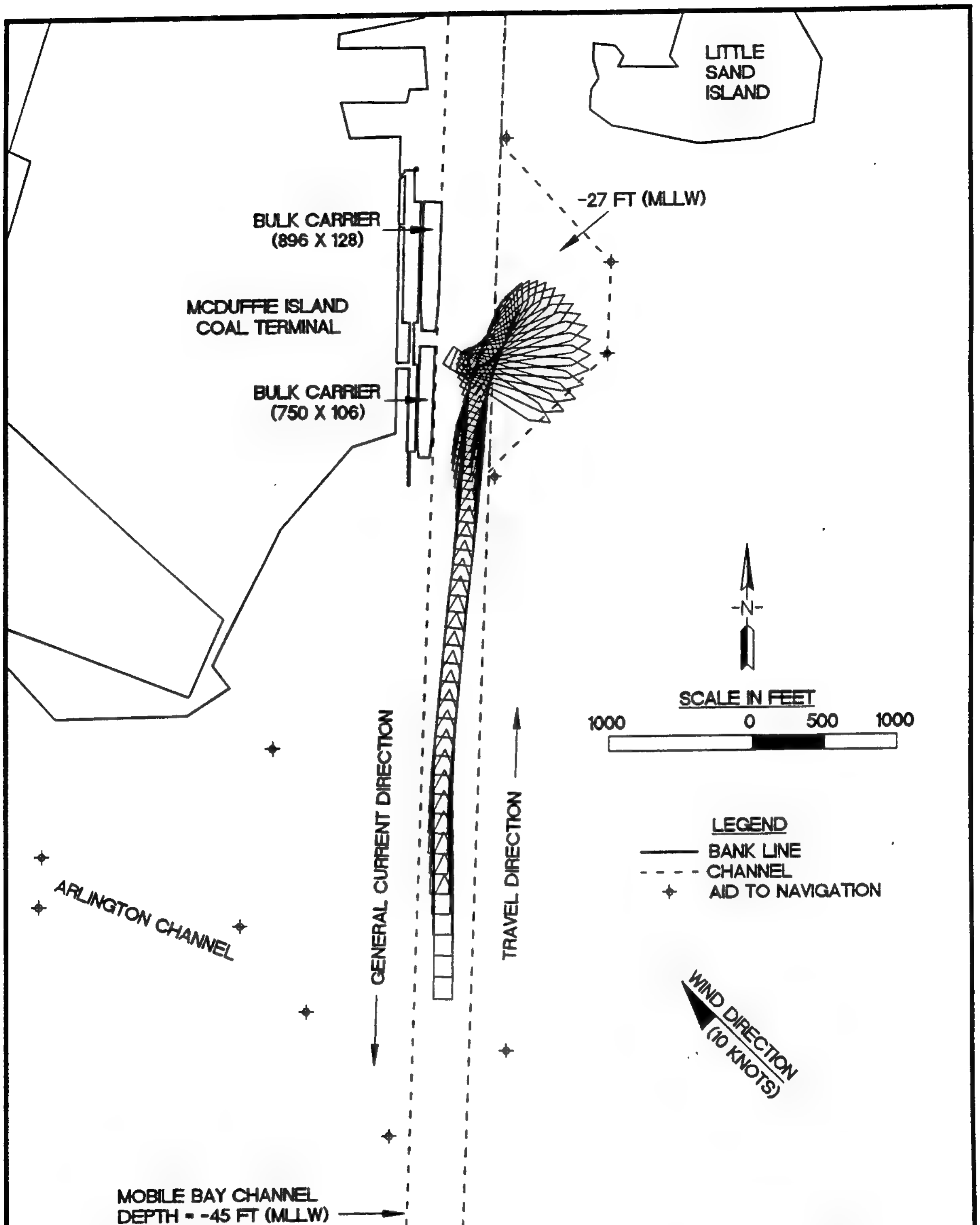
LITTLE
SAND
ISLAND
-27 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT G, RUN 1


PILOT TUG USAGE
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT G, RUN 1
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
SHIP ENTERS TURNING BASIN
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT

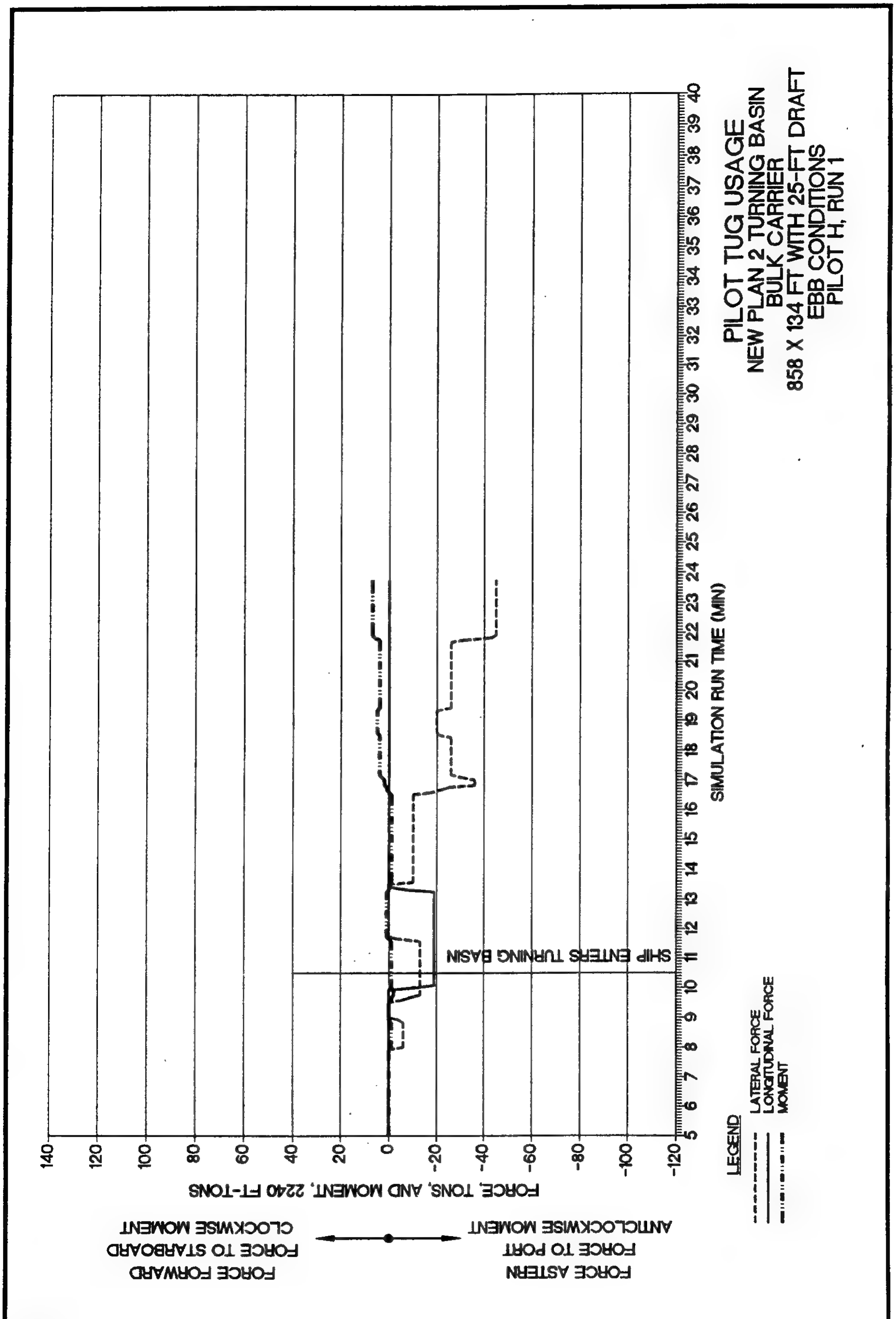

LITTLE
SAND
ISLAND
-27 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
N
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT G, RUN 2



PILOT TUG USAGE
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT G, RUN 2



PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT H, RUN 1


PILOT TUG USAGE
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT H, RUN 1
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT
140
120
100
80
60
40
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-20
-40
-60
-80
-100
-120
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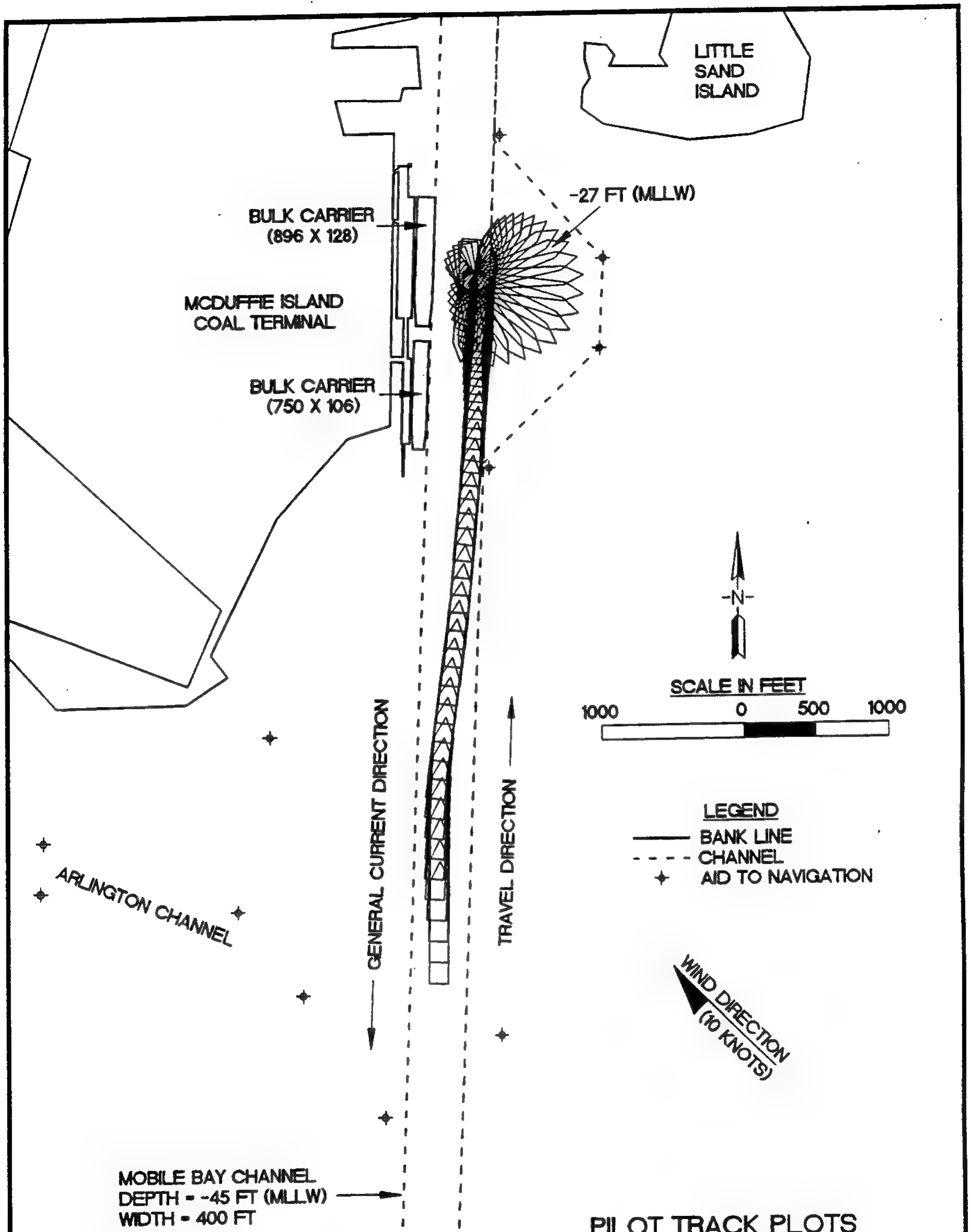
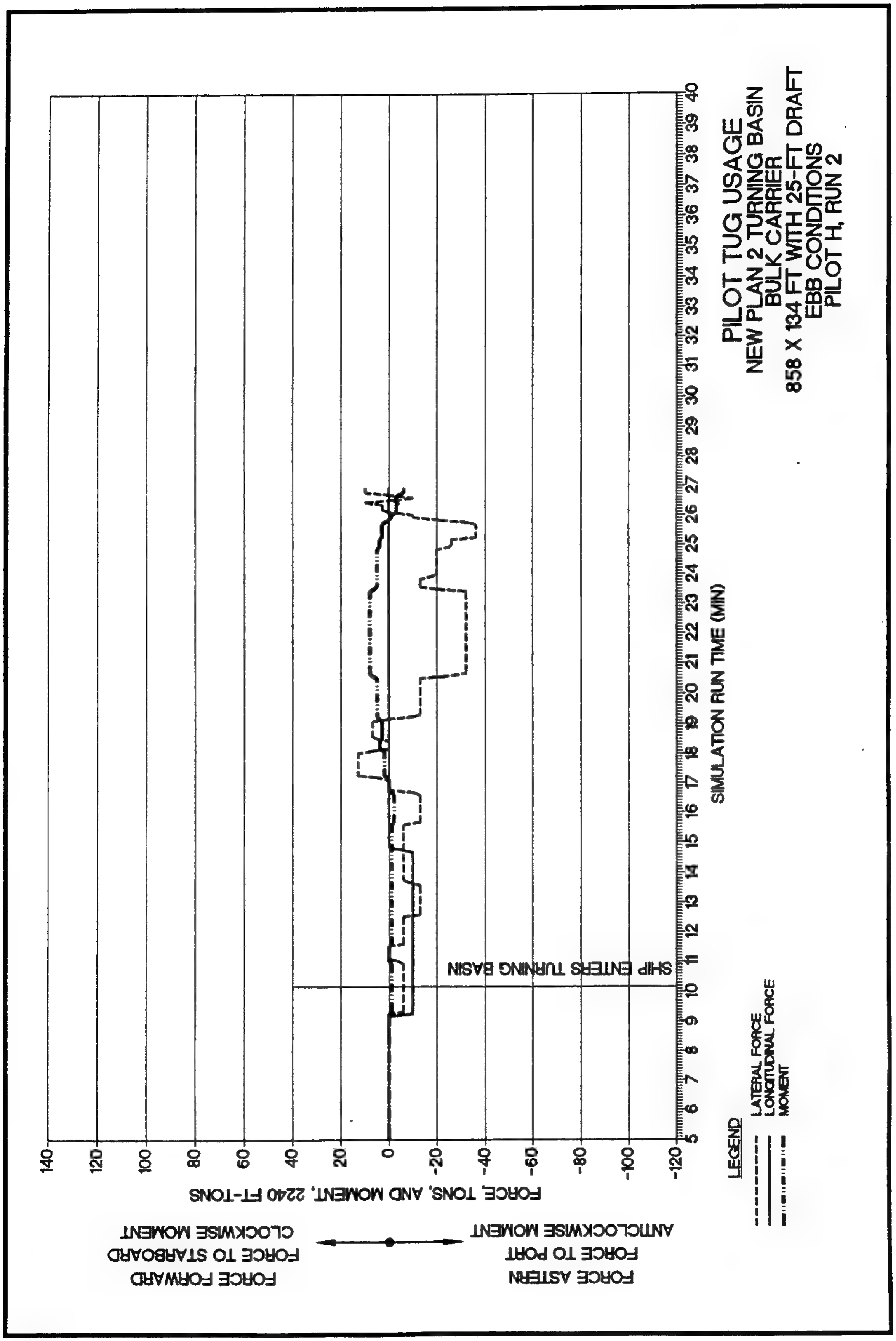
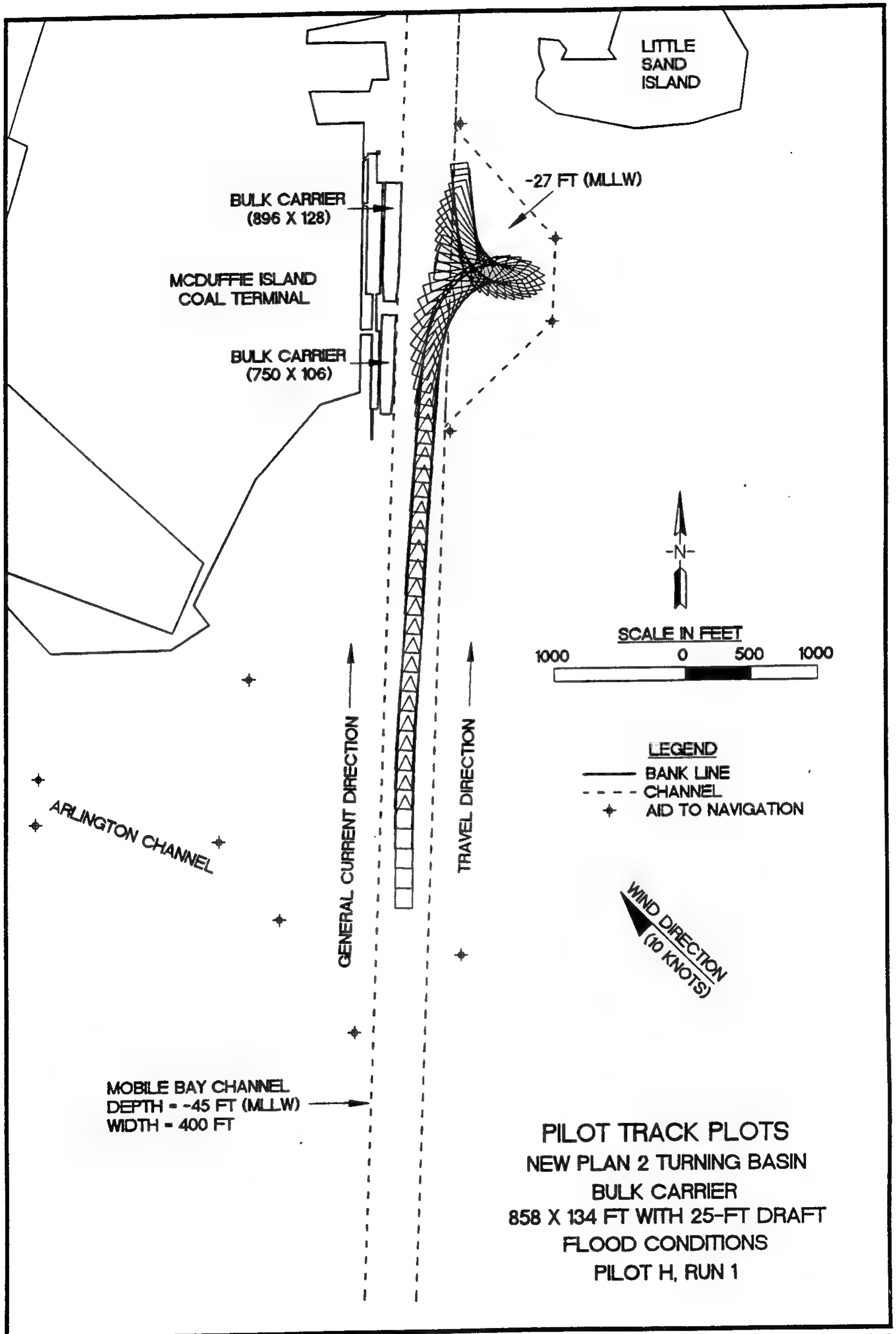
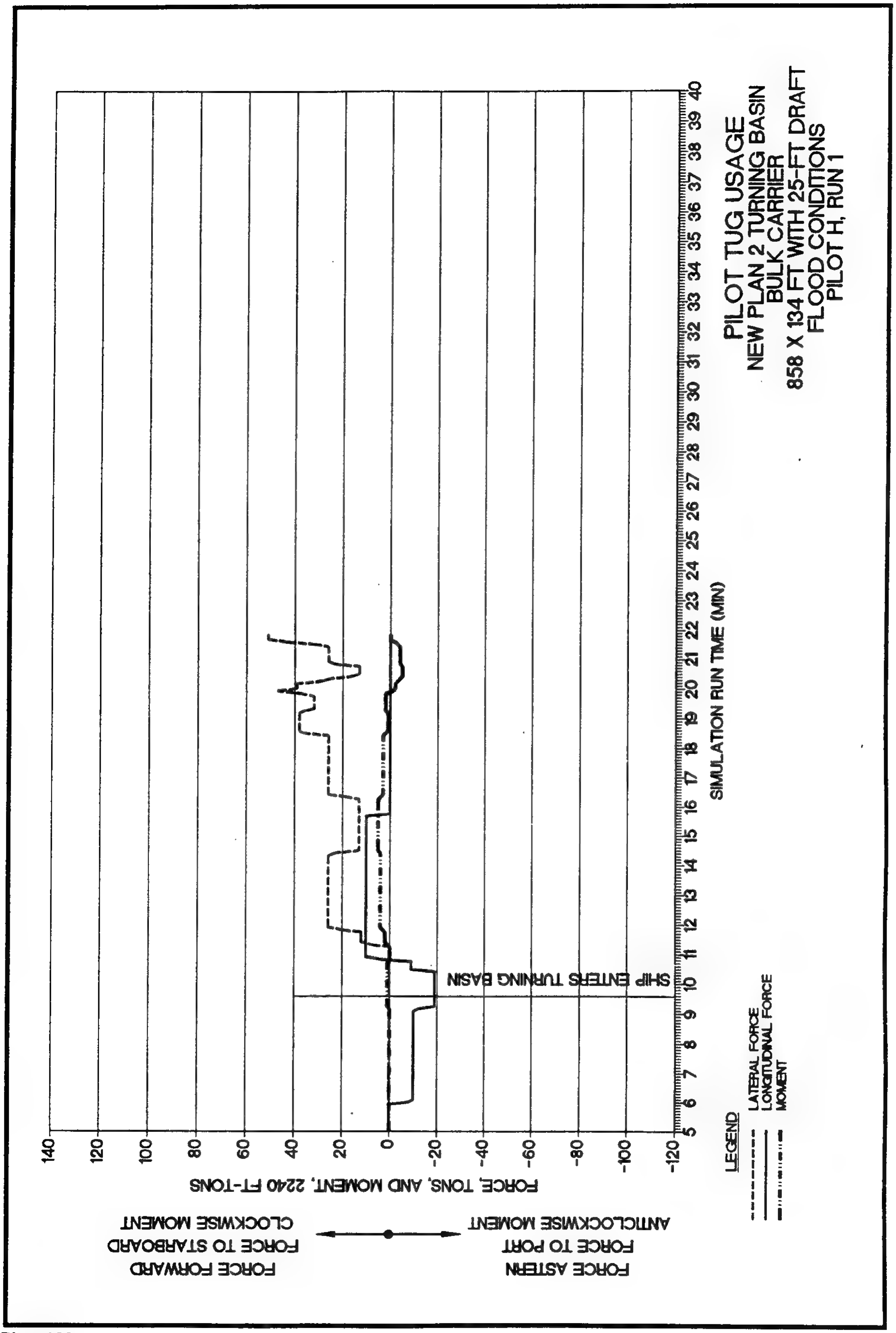
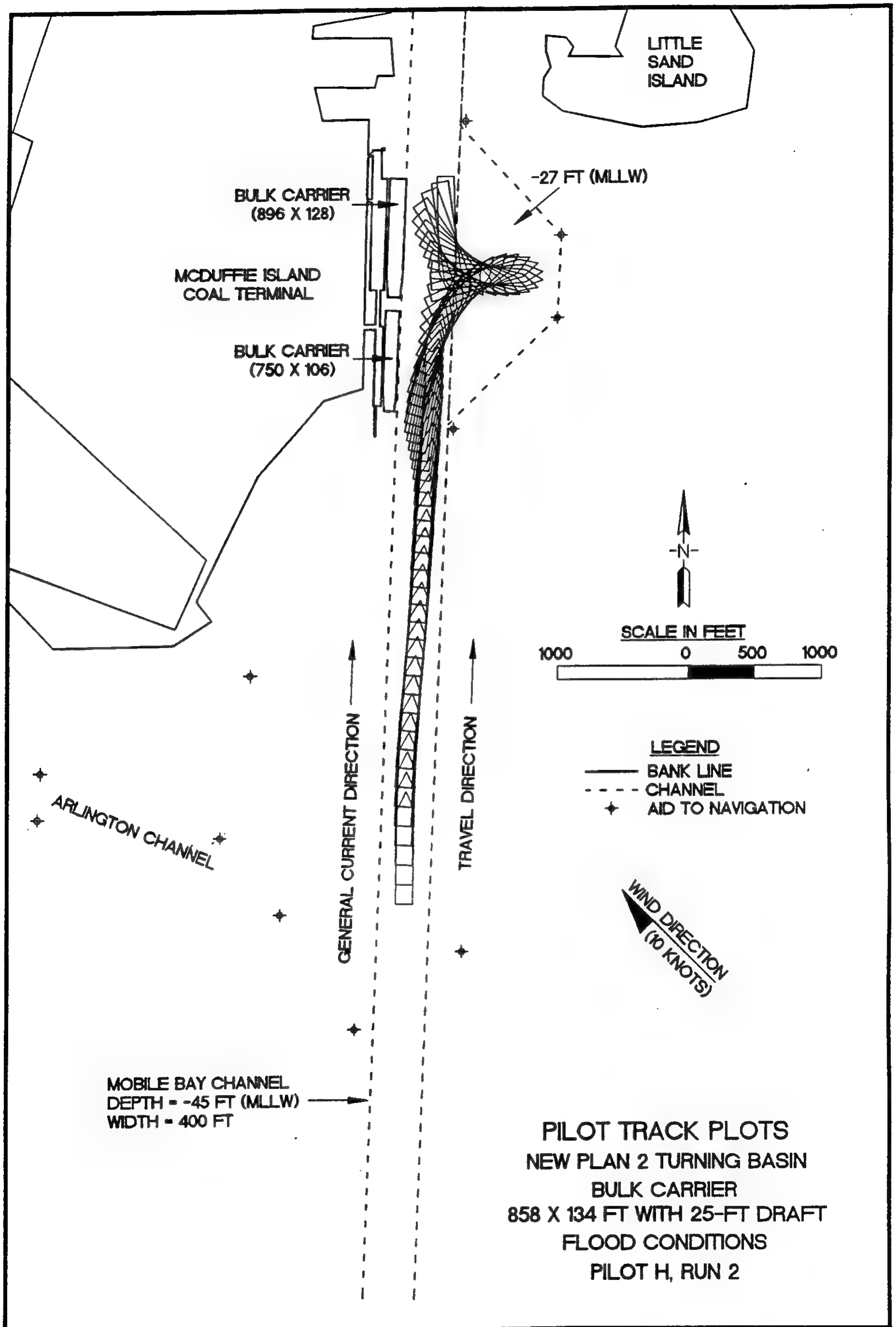


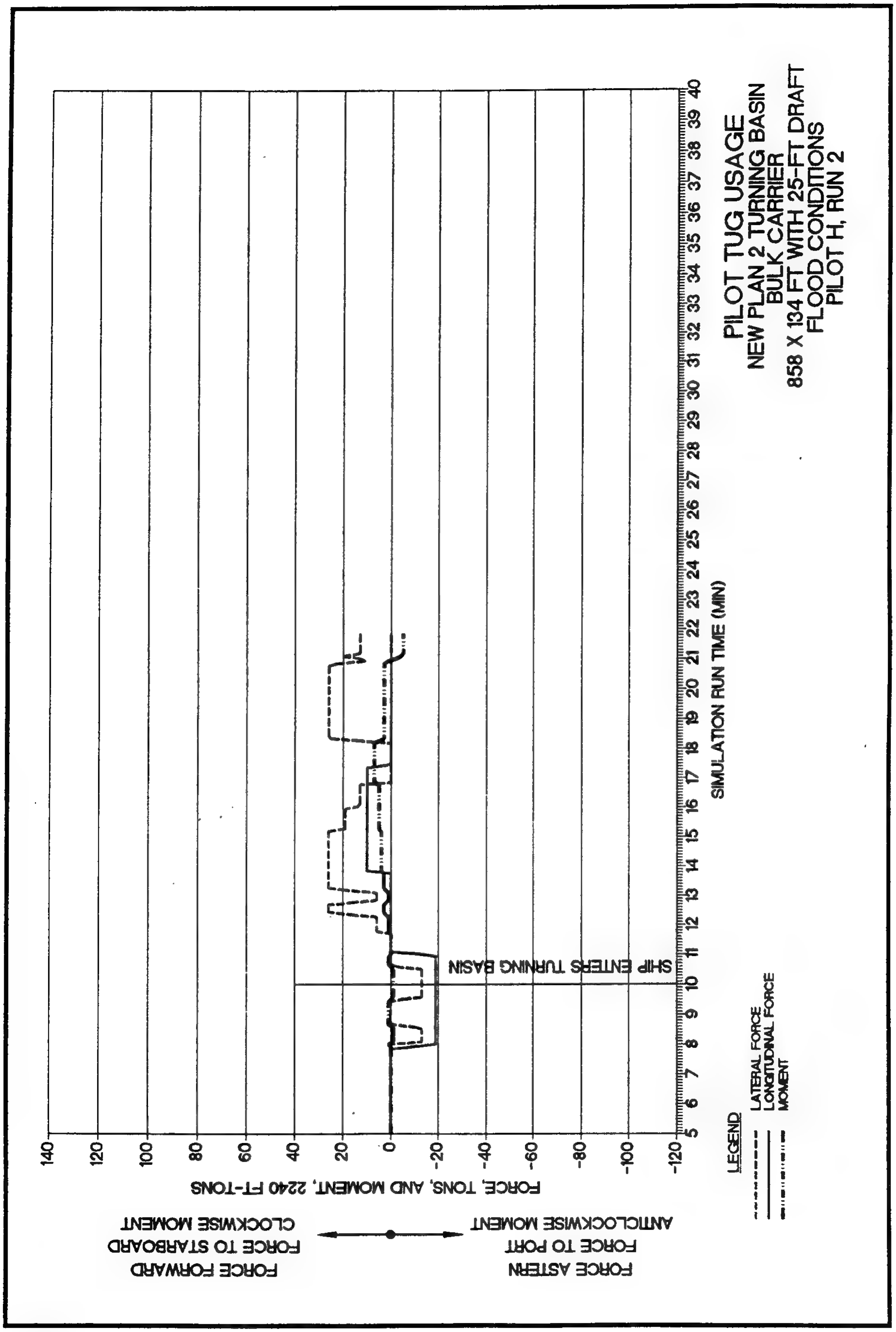
PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT H, RUN 2


PILOT TUG USAGE
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT H, RUN 2
SHIP ENTERS TURNING BASIN
SIMULATION RUN TIME (MIN)
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
FORCE, TONS, AND MOMENT, 2240 FT-TONS
140 120 100 80 60 40 20 0 -20 -40 -60 -80 -100 -120
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT


LITTLE SAND ISLAND
-27 FT (MLLW)
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT H, RUN 1


PILOT TUG USAGE
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT H, RUN 1
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
SHIP ENTERS TURNING BASIN
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT


LITTLE SAND ISLAND
-27 FT (MLLW)
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT H, RUN 2


PILOT TUG USAGE
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT H, RUN 2
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
SHIP ENTERS TURNING BASIN
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT
140
120
100
80
60
40
20
0
-20
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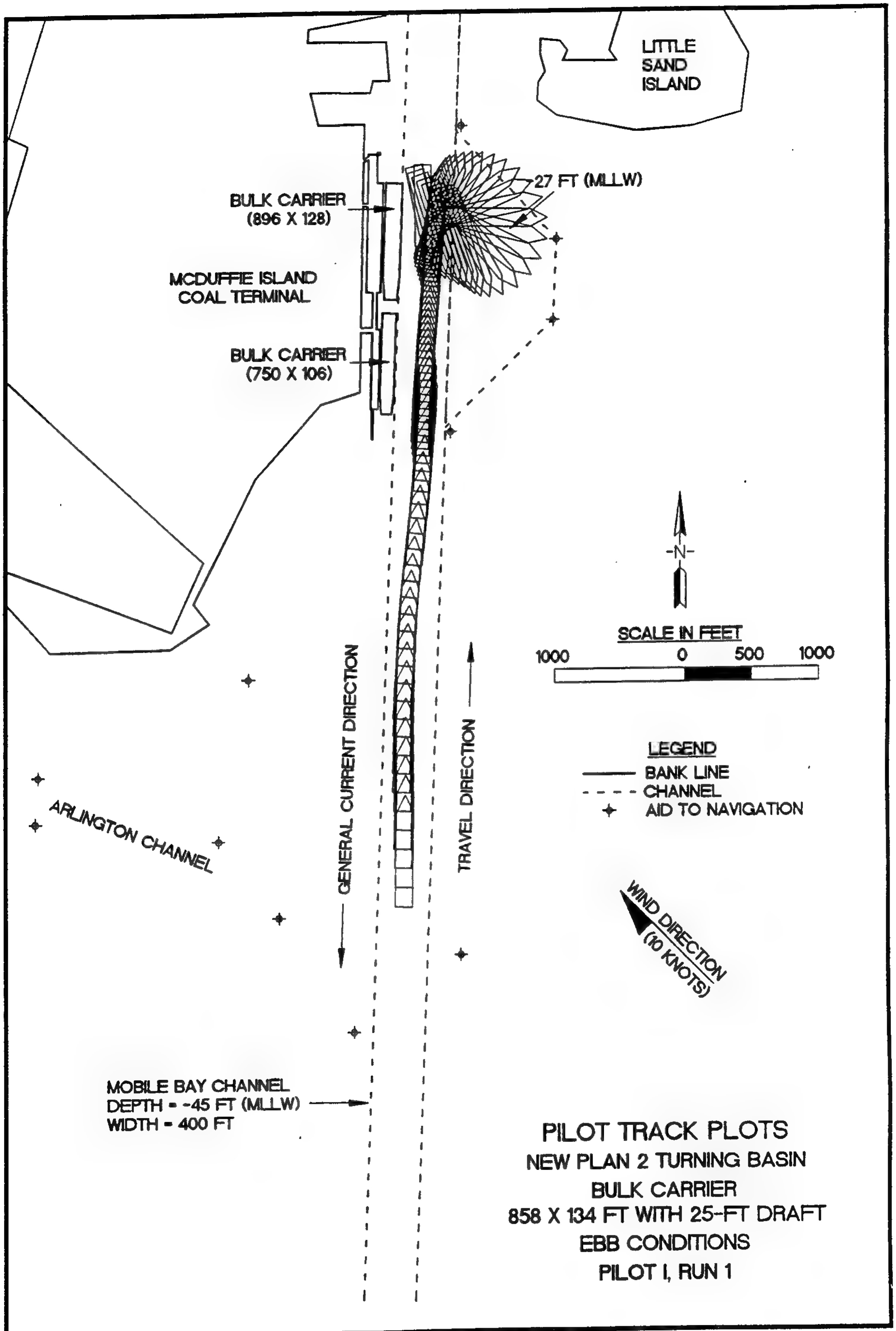
-80
-100
-120
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40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SAND
ISLAND
27 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
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SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
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AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
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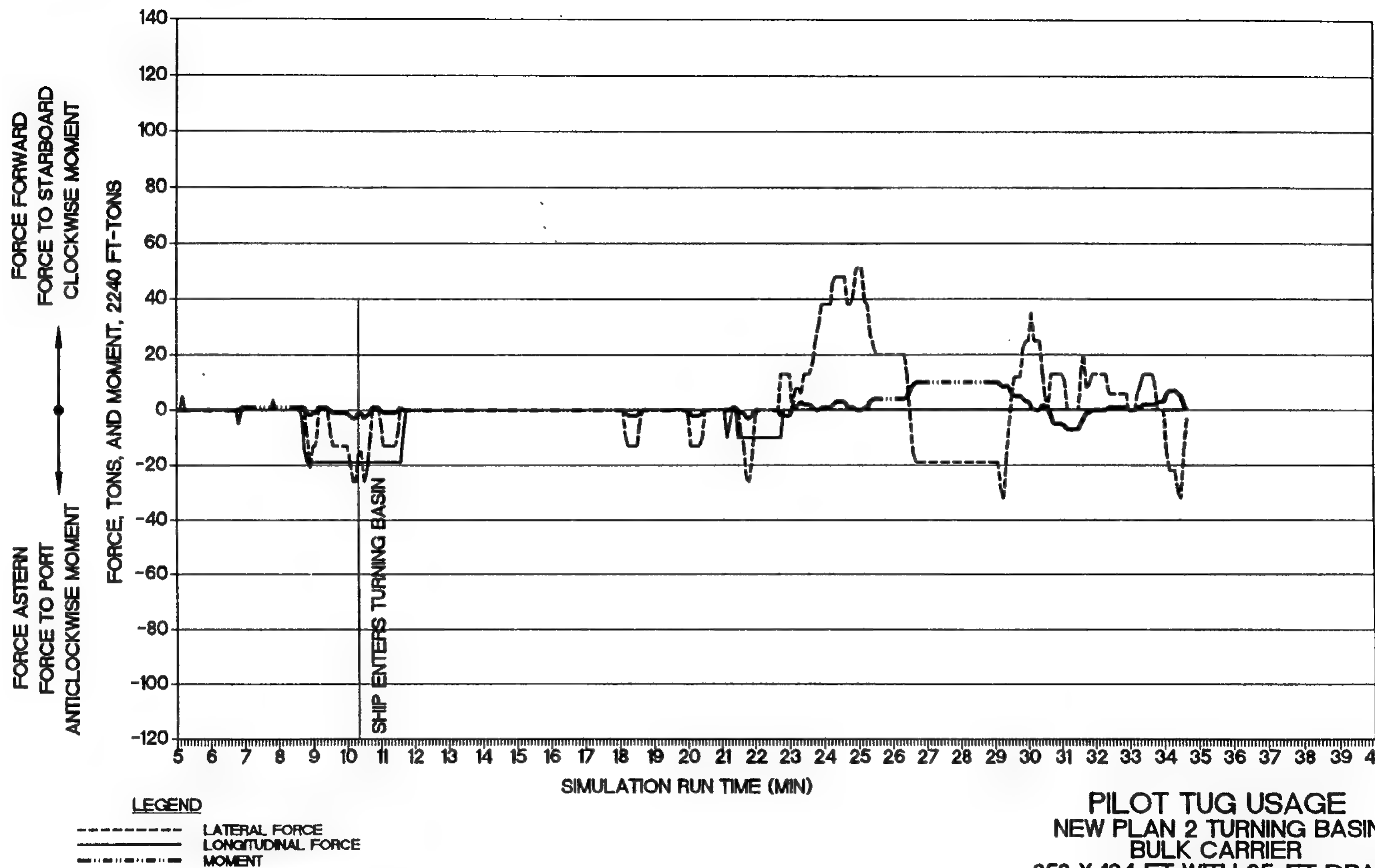
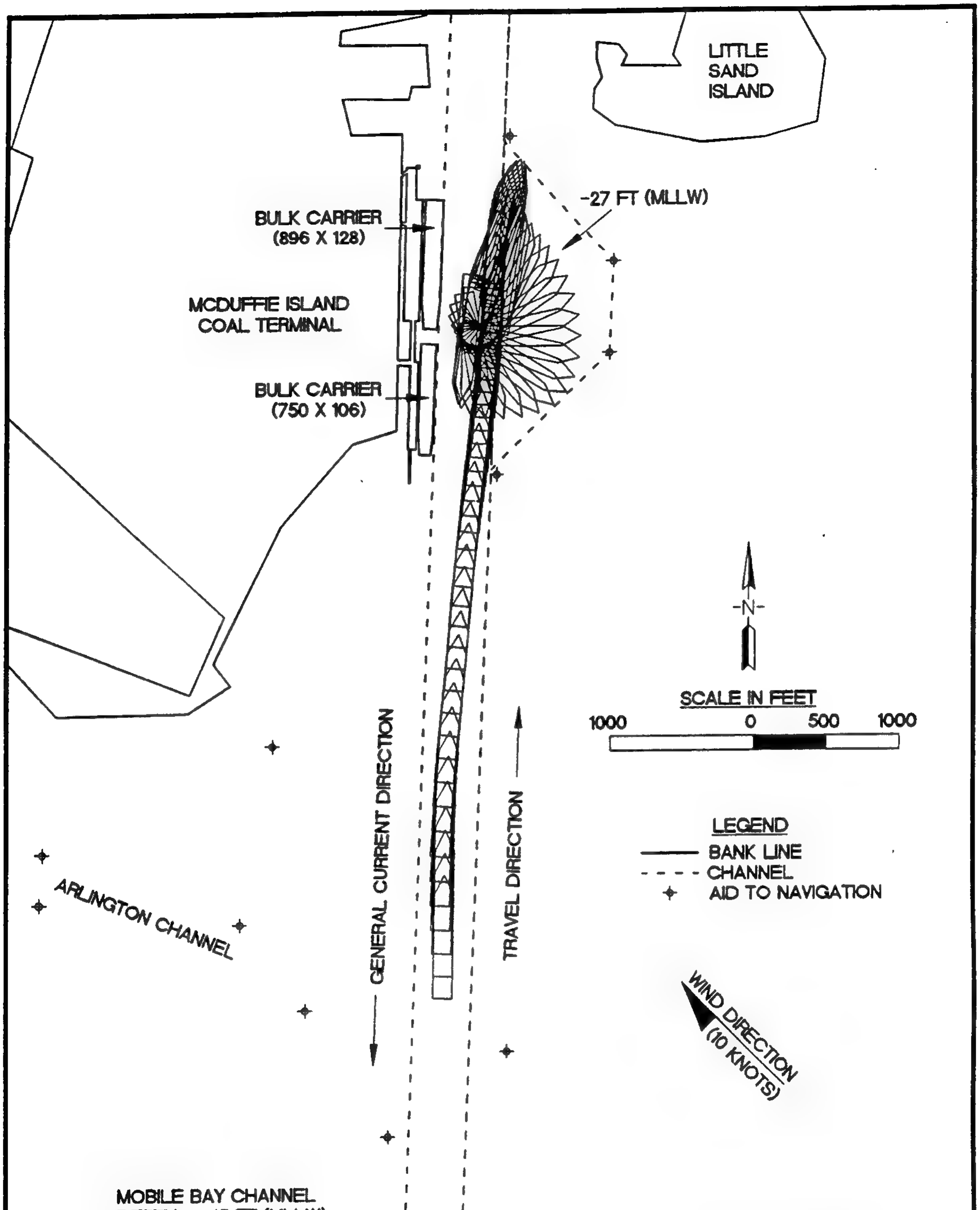
PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT I, RUN 1

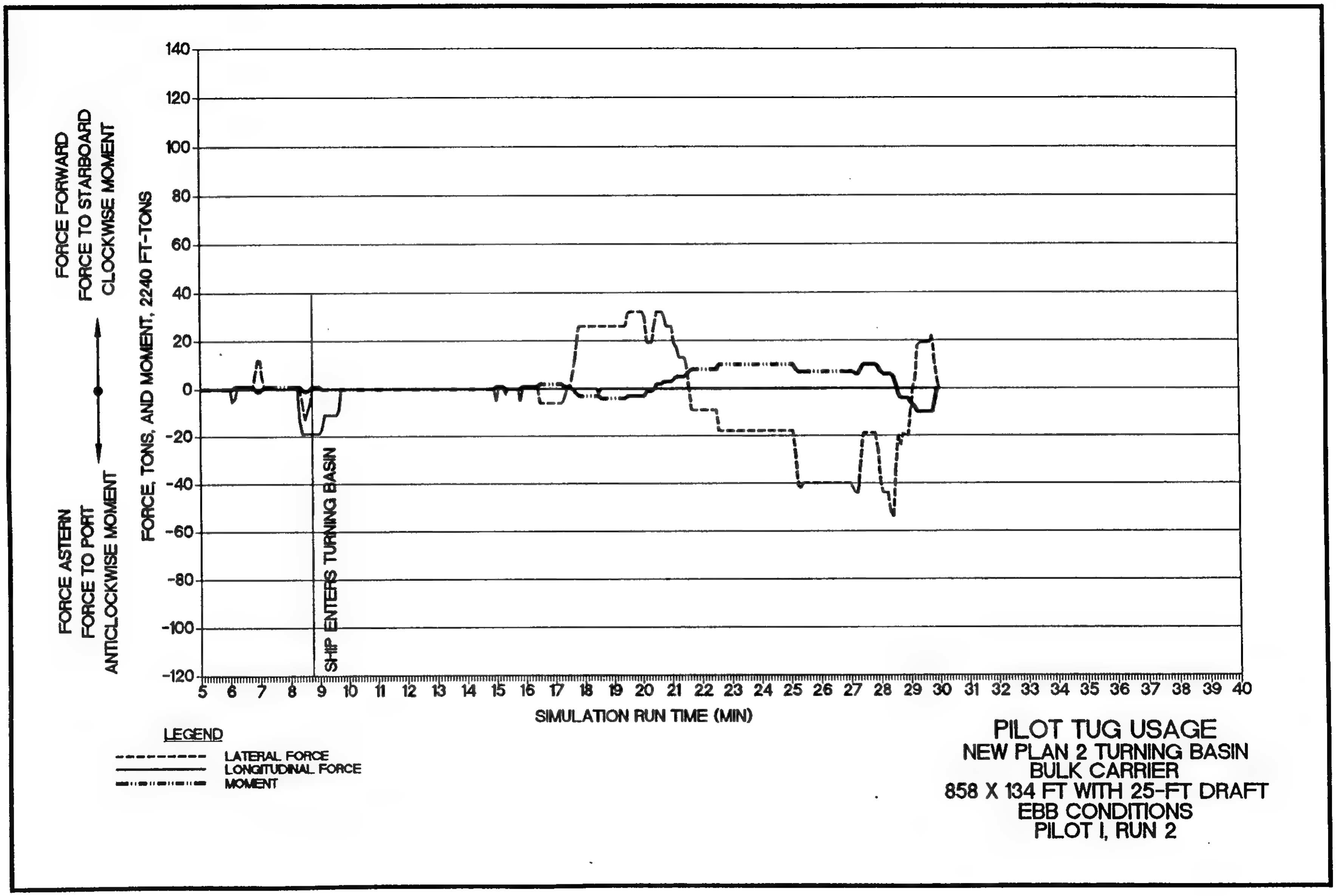


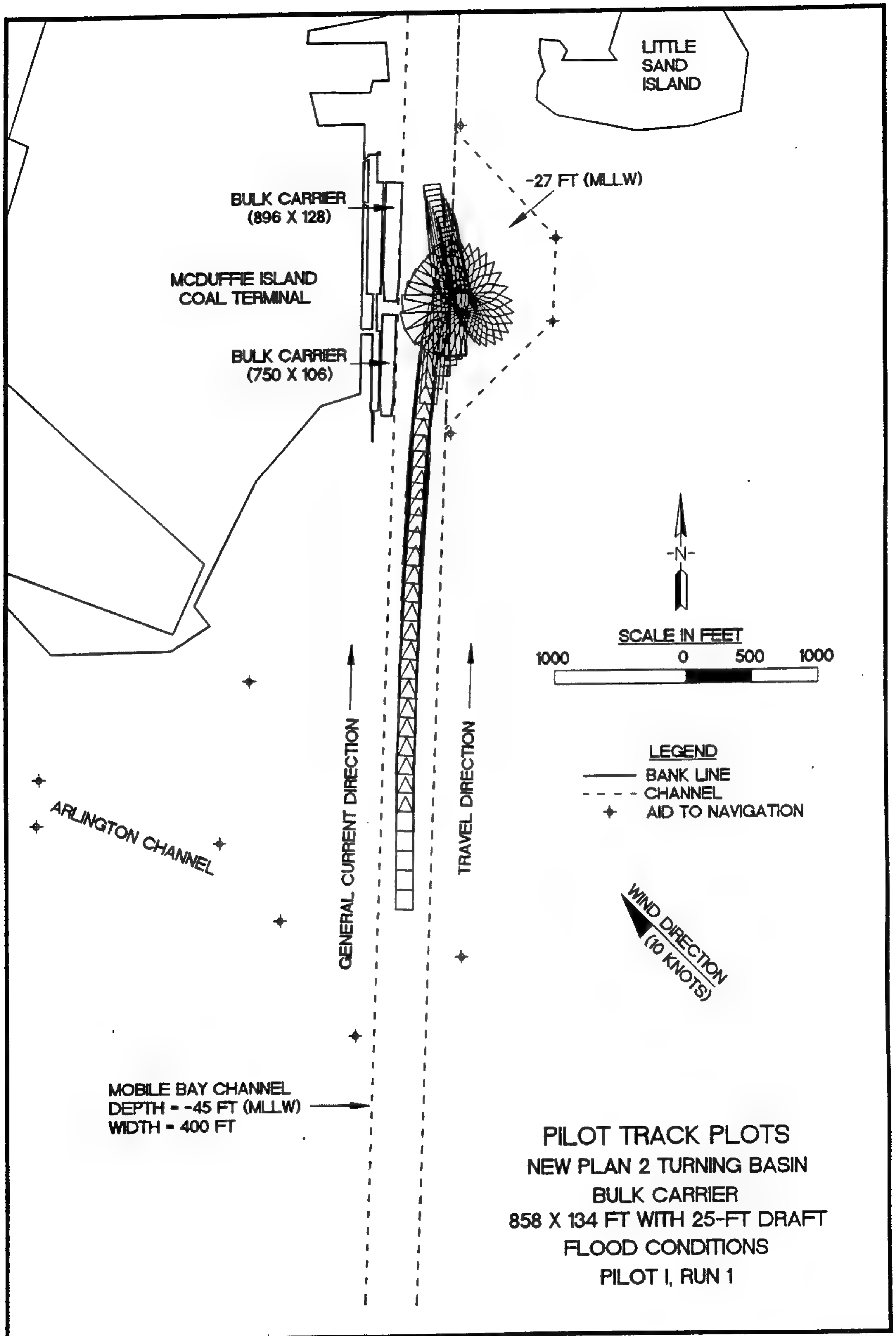
PILOT TUG USAGE
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT I, RUN 1

164



PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT I, RUN 2


FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE, TONS, AND MOMENT, 2240 FT-TONS
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
SHIP ENTERS TURNING BASIN
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
SIMULATION RUN TIME (MIN)
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT
PILOT TUG USAGE
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT I, RUN 2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SAND
ISLAND
-27 FT (MLLW)
BULK CARRIER
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COAL TERMINAL
BULK CARRIER
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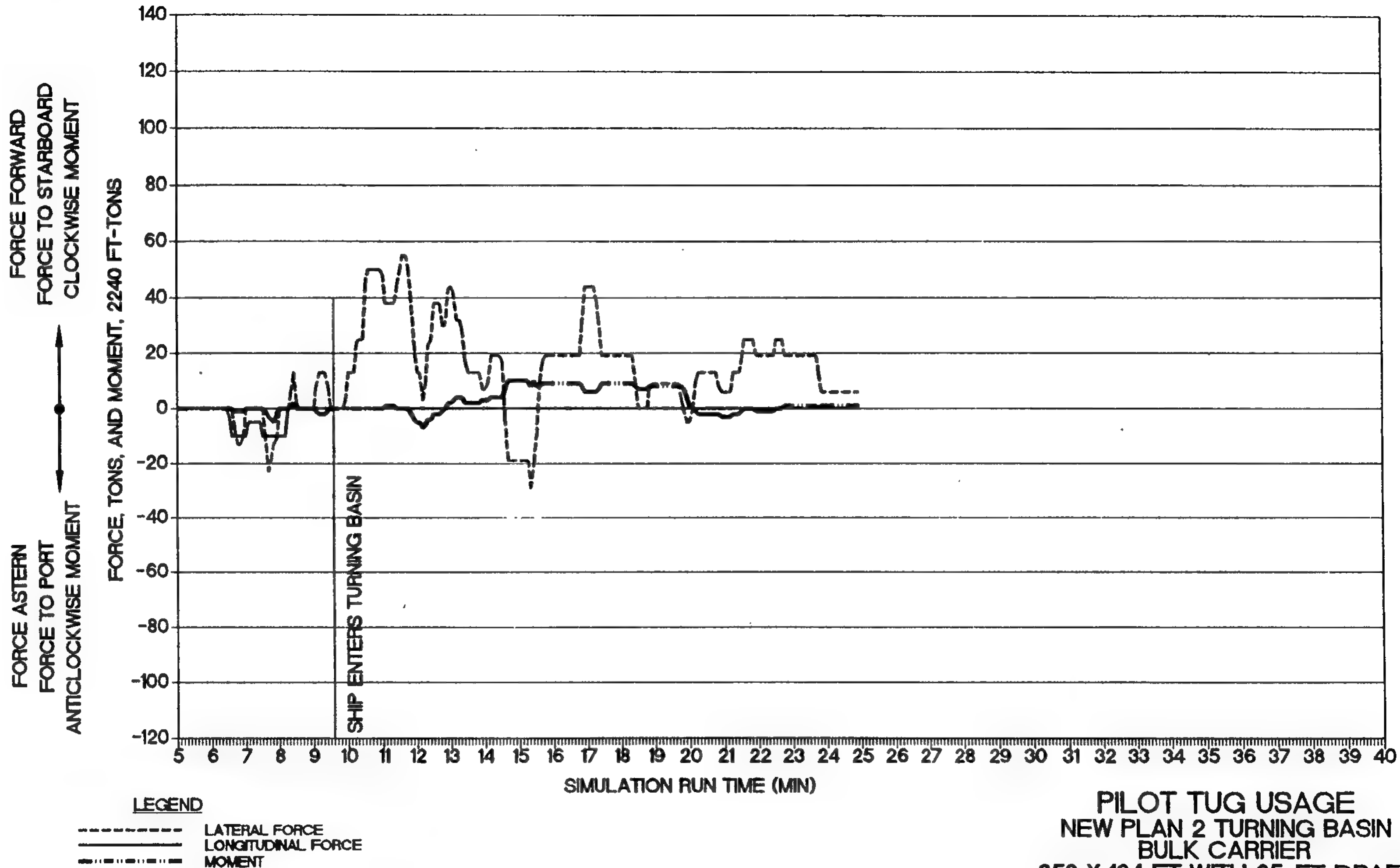
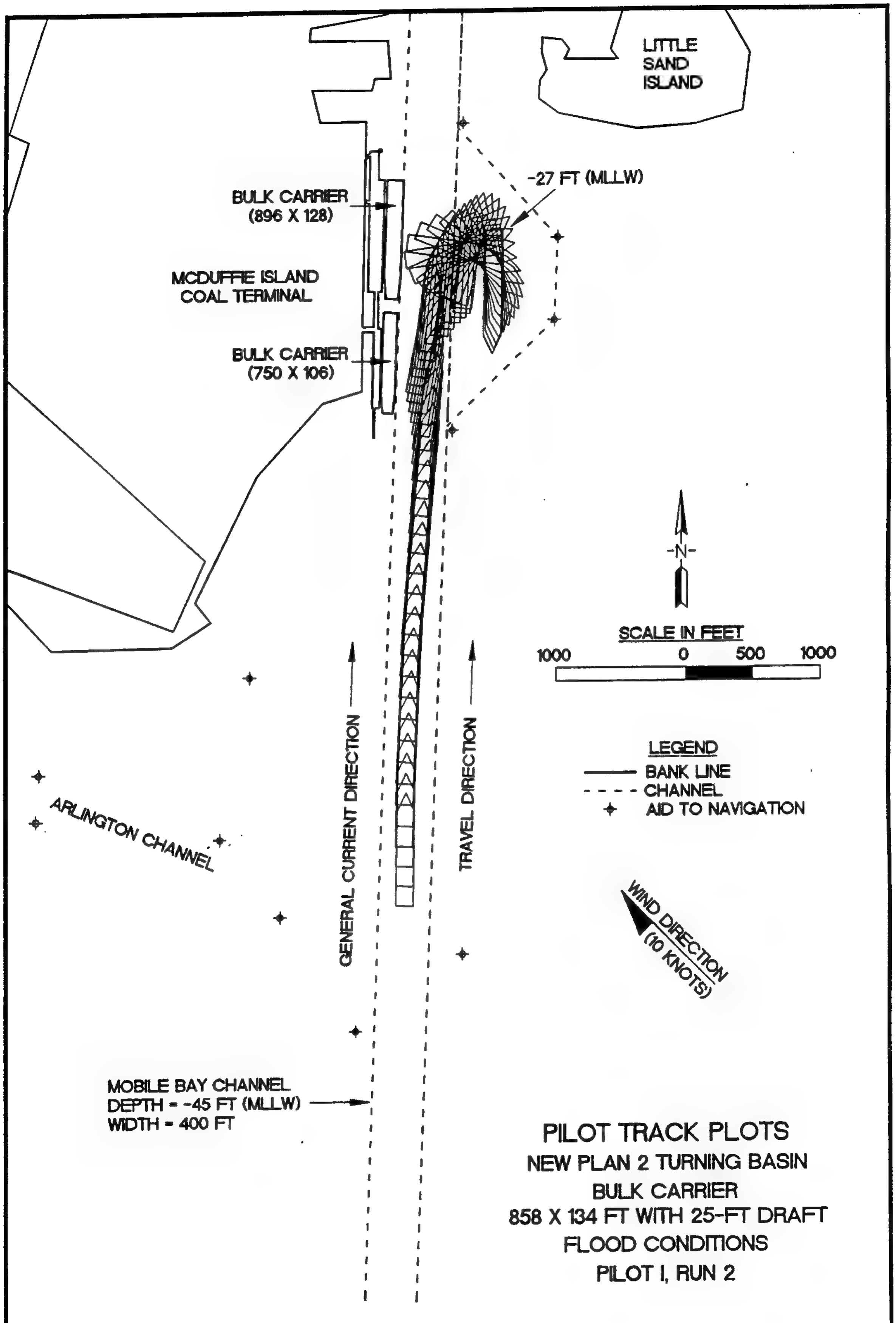
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT I, RUN 1



PILOT TUG USAGE
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT I, RUN 1



LITTLE SAND ISLAND
-27 FT (MLLW)
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
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SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
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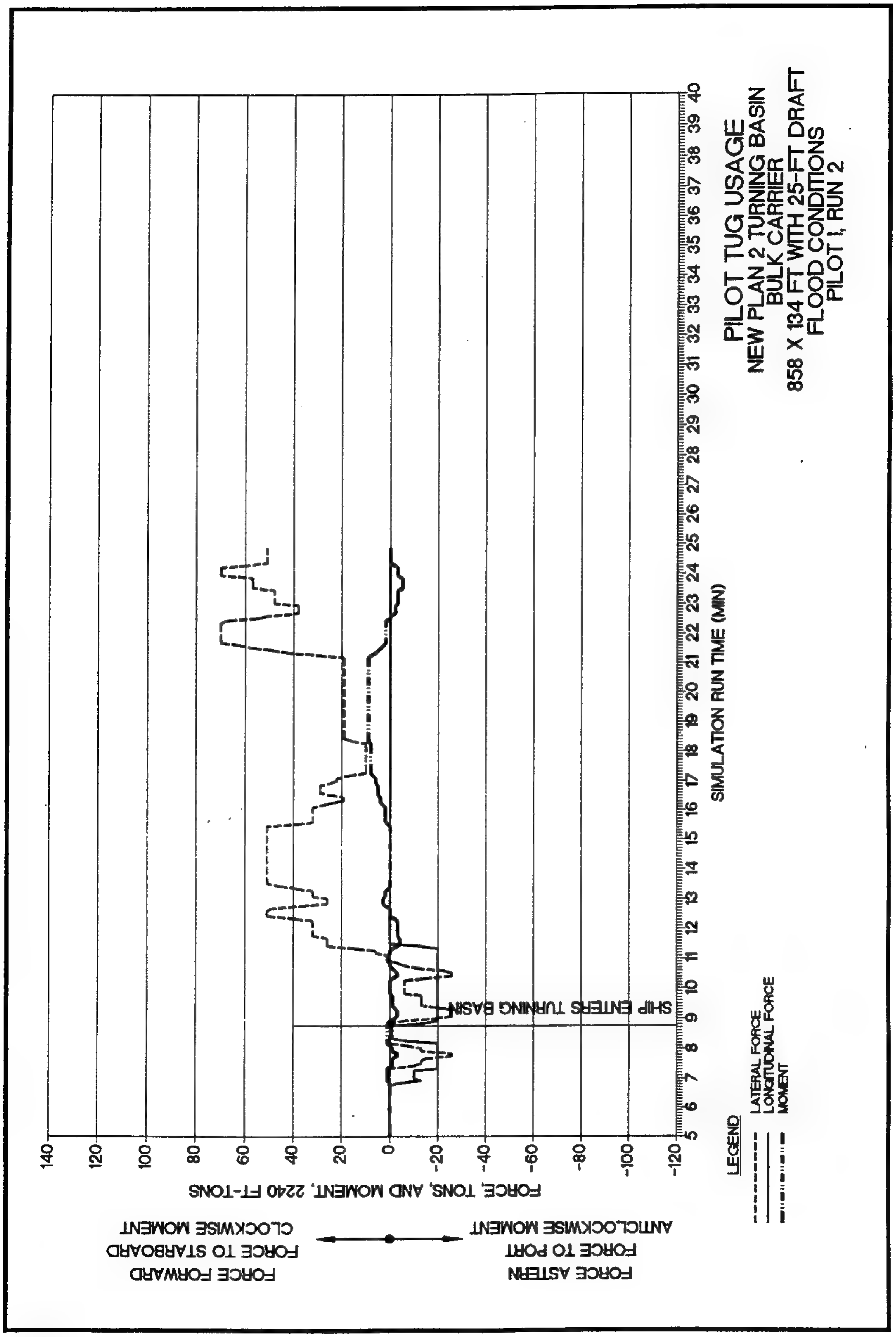
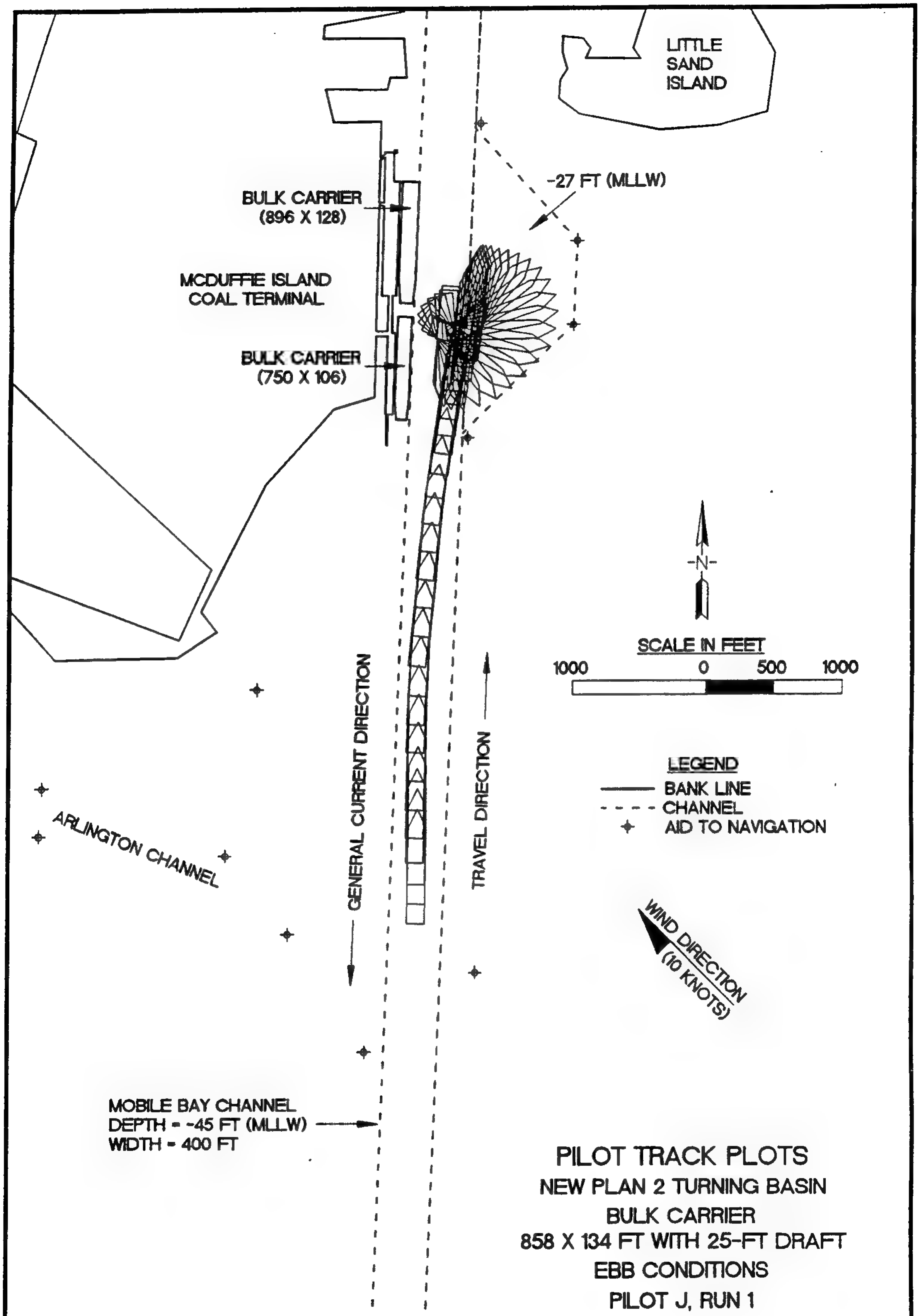
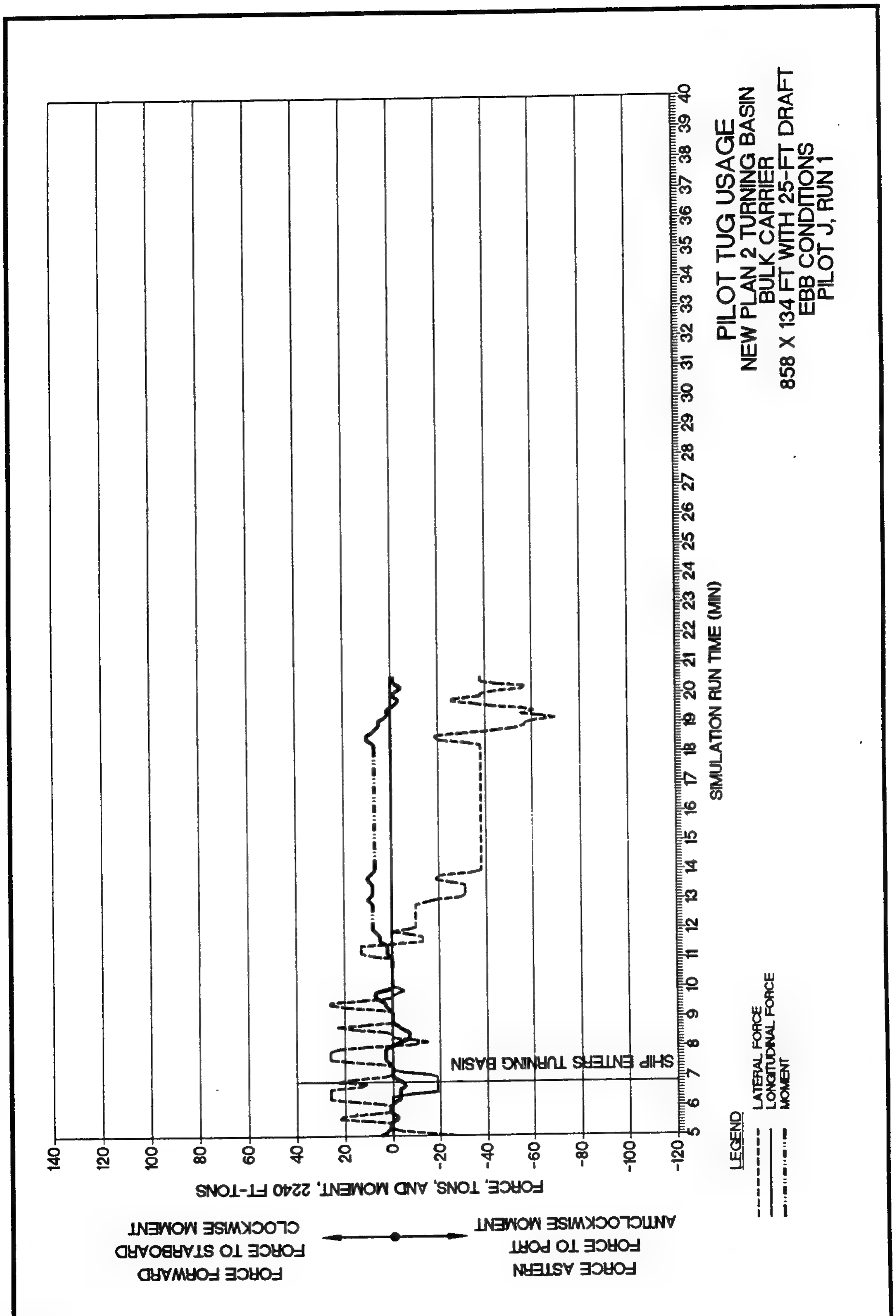
PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT I, RUN 2


PILOT TUG USAGE
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT I, RUN 2
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT



PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT J, RUN 1



PILOT TUG USAGE
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT J, RUN 1
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT
140
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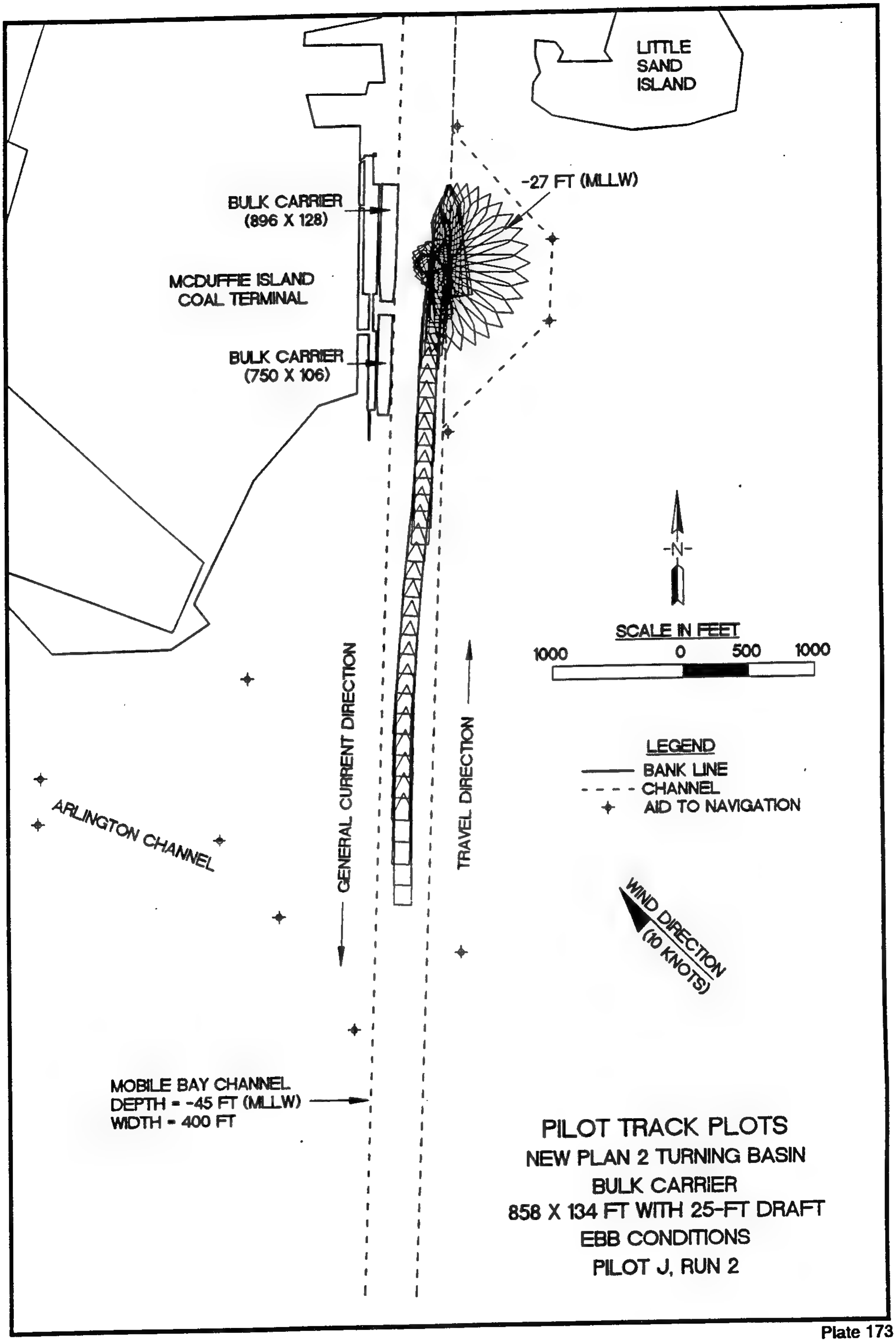
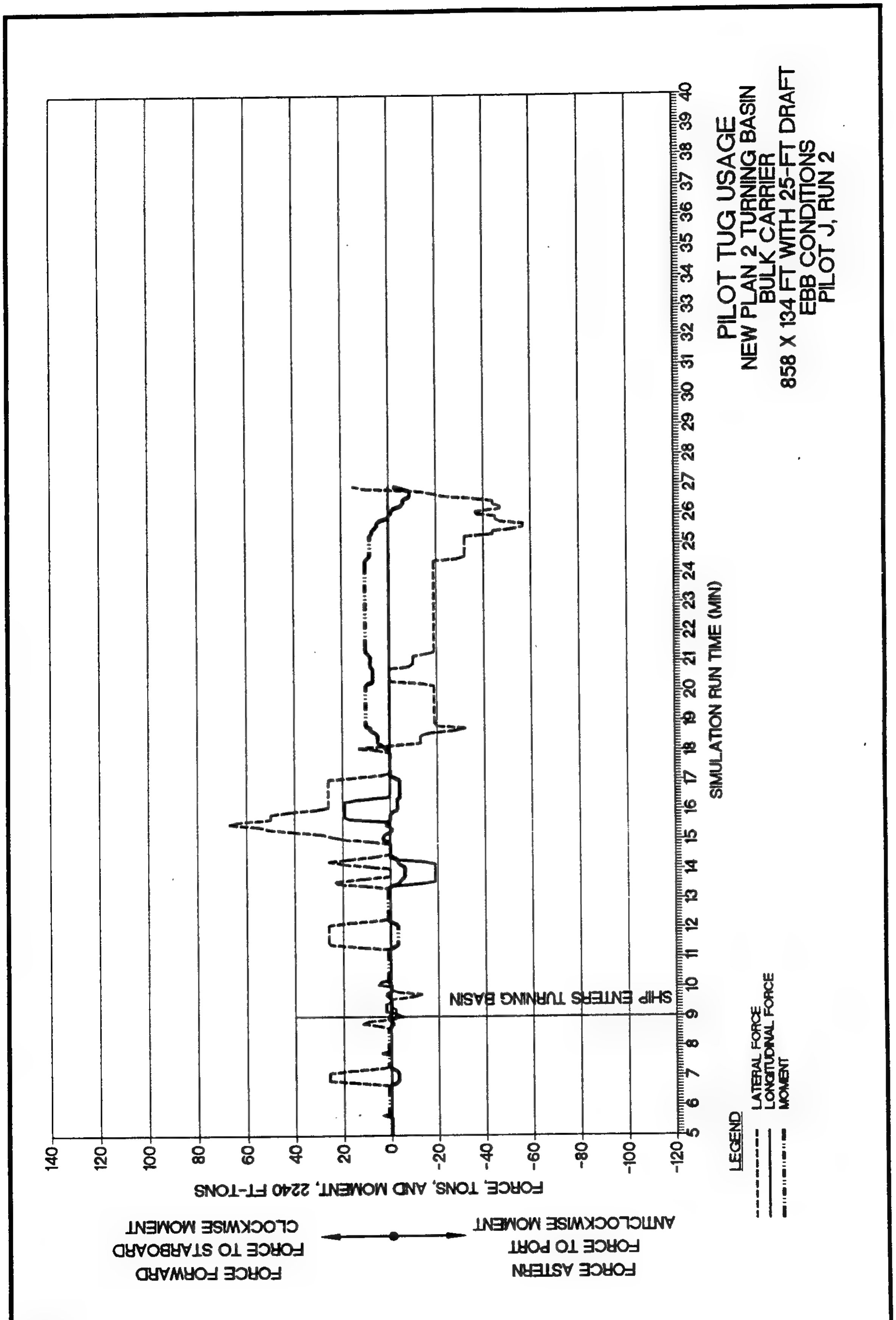
Plate 172



LITTLE
SAND
ISLAND
-27 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT J, RUN 2



PILOT TUG USAGE
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT J, RUN 2
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT

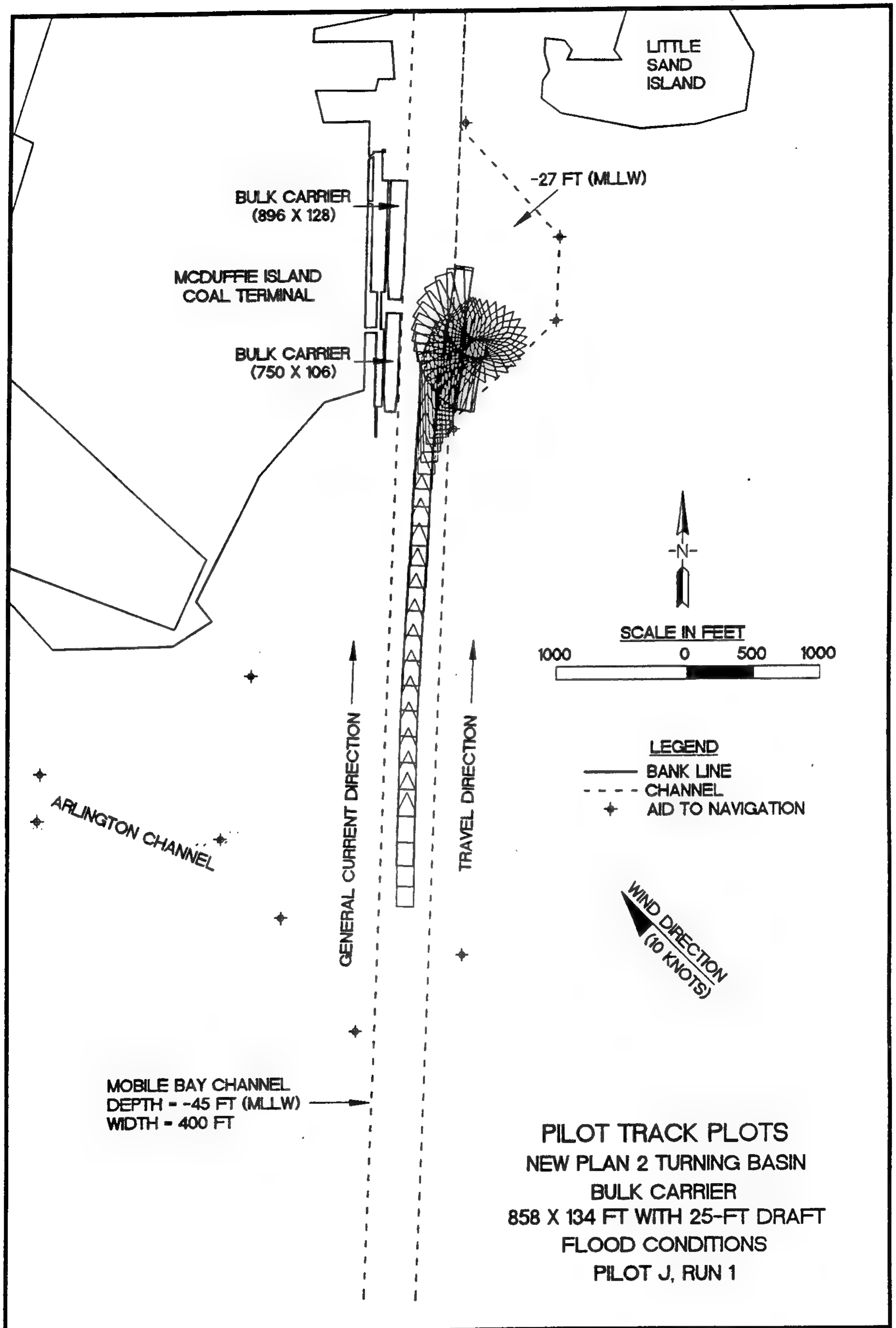
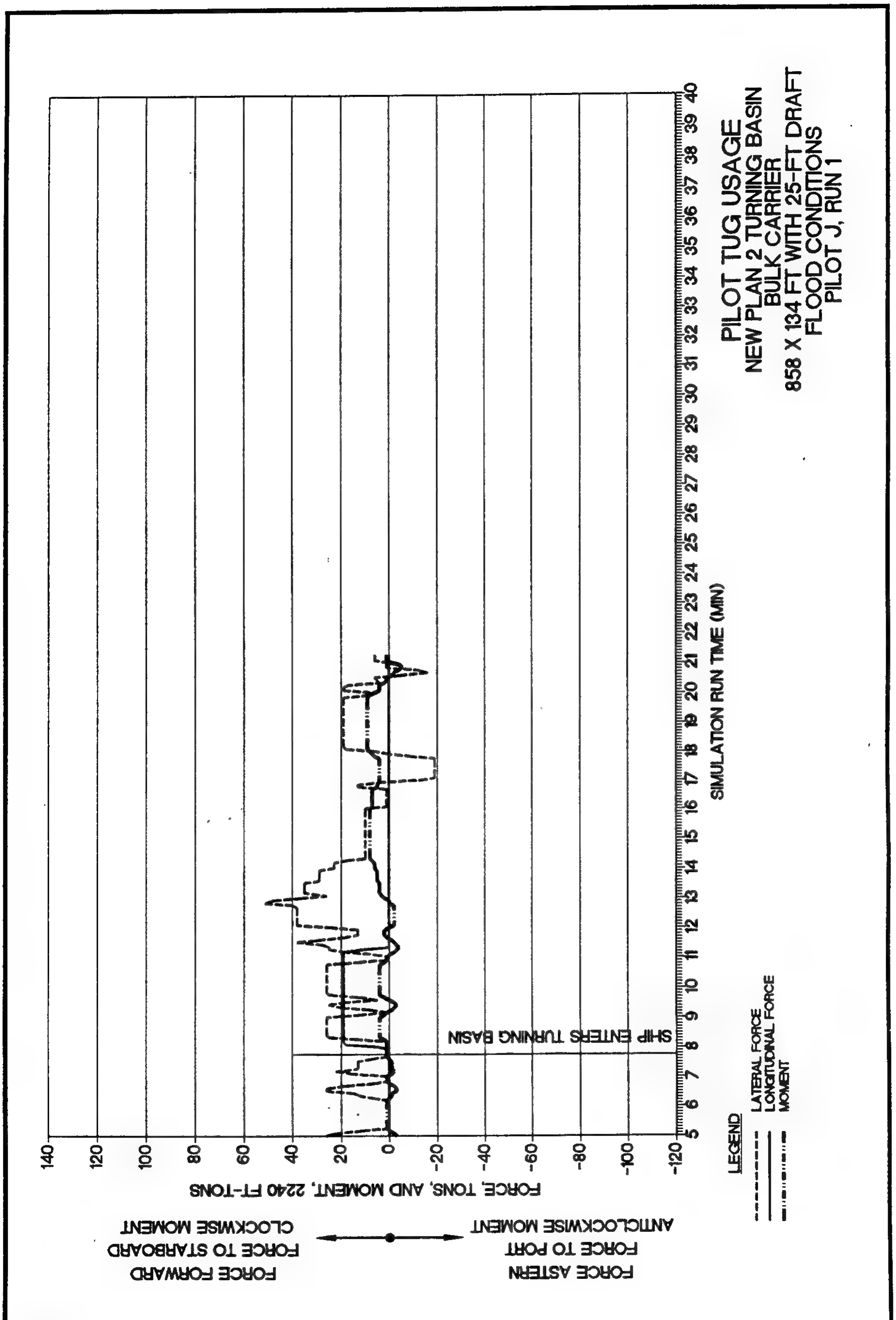

LITTLE
SAND
ISLAND
-27 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT J, RUN 1

Plate 175



PILOT TUG USAGE
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT J, RUN 1
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
SHIP ENTERS TURNING BASIN
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT
140
120
100
80
60
40
20
0
-20
-40
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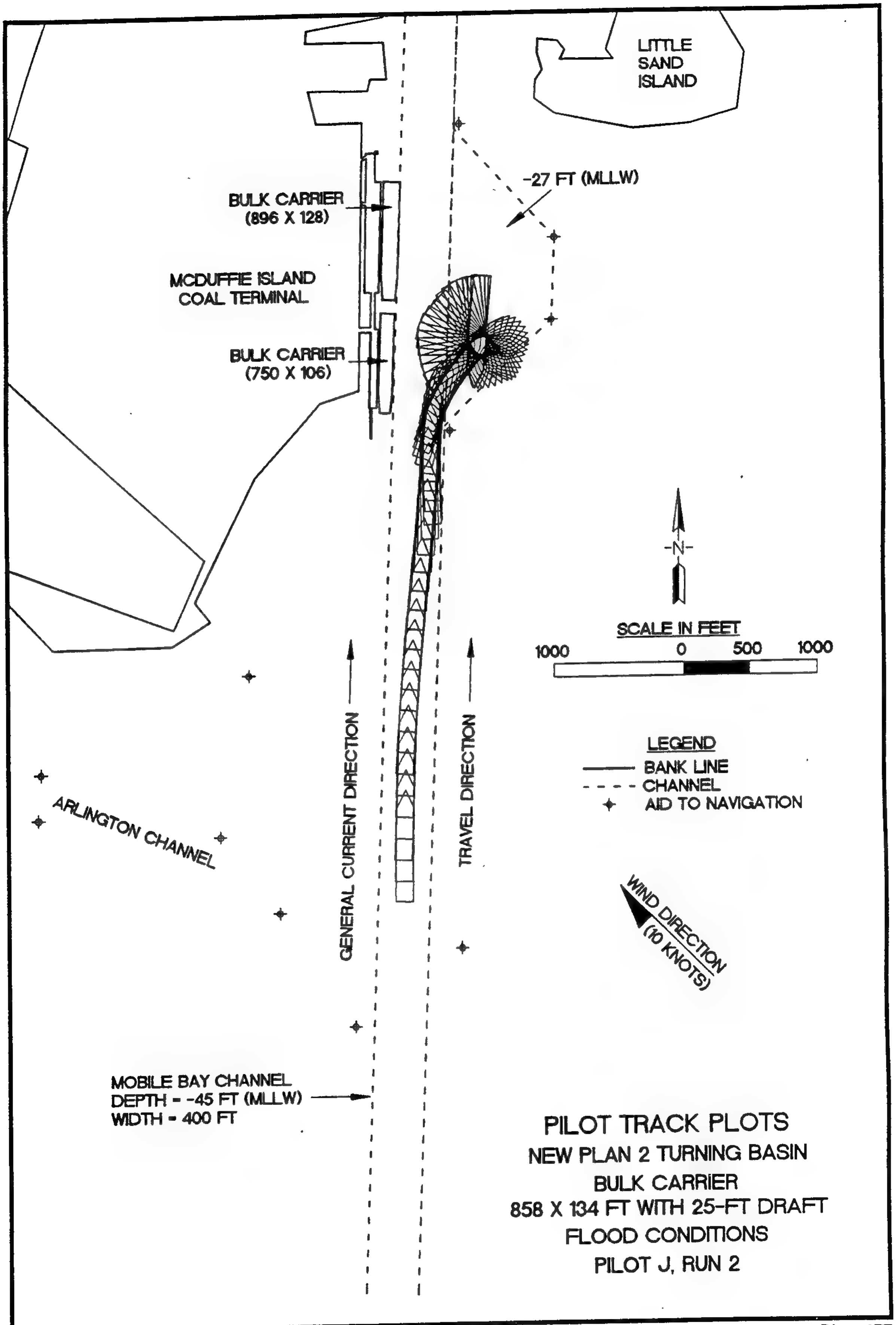
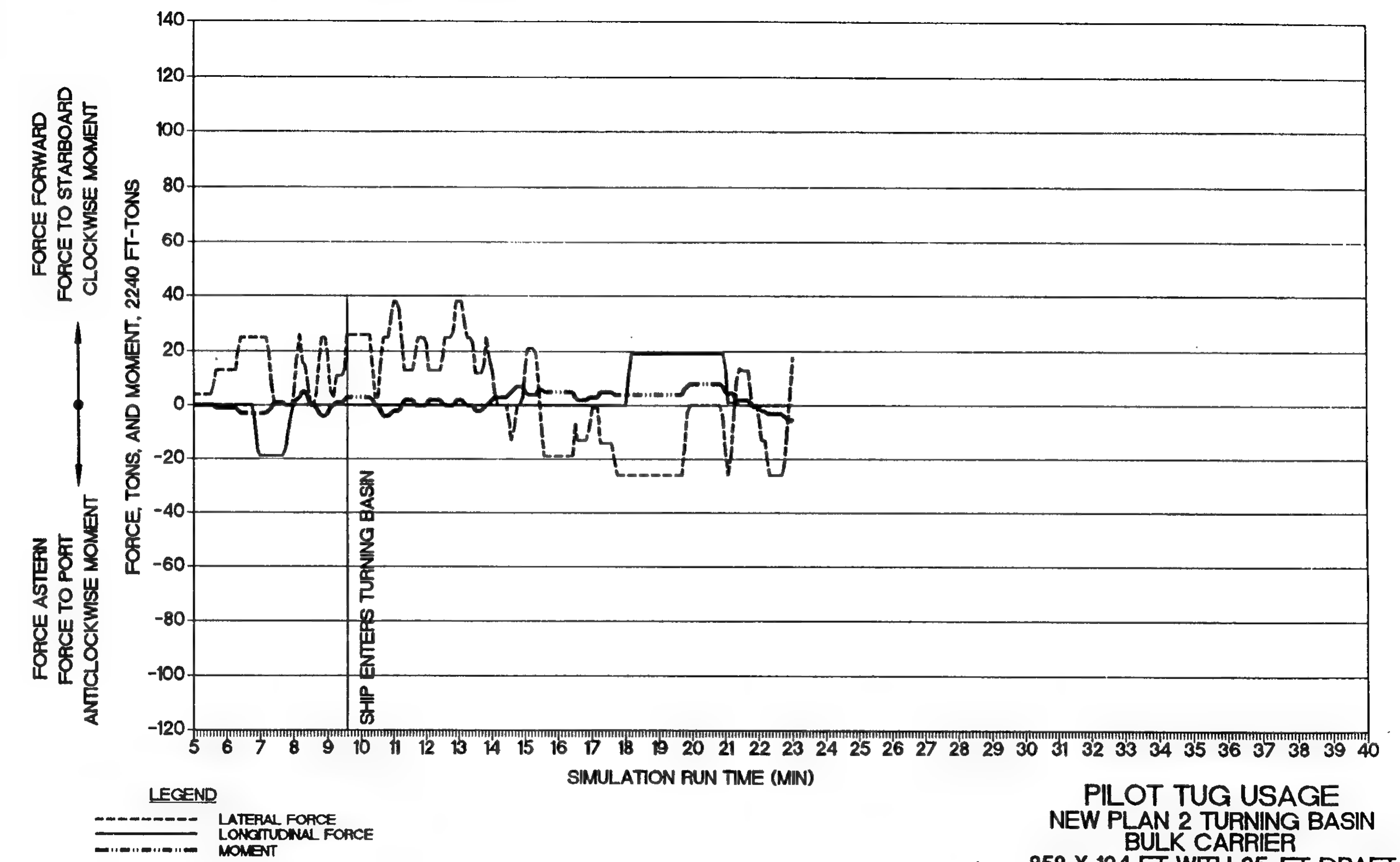
-80
-100
-120
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

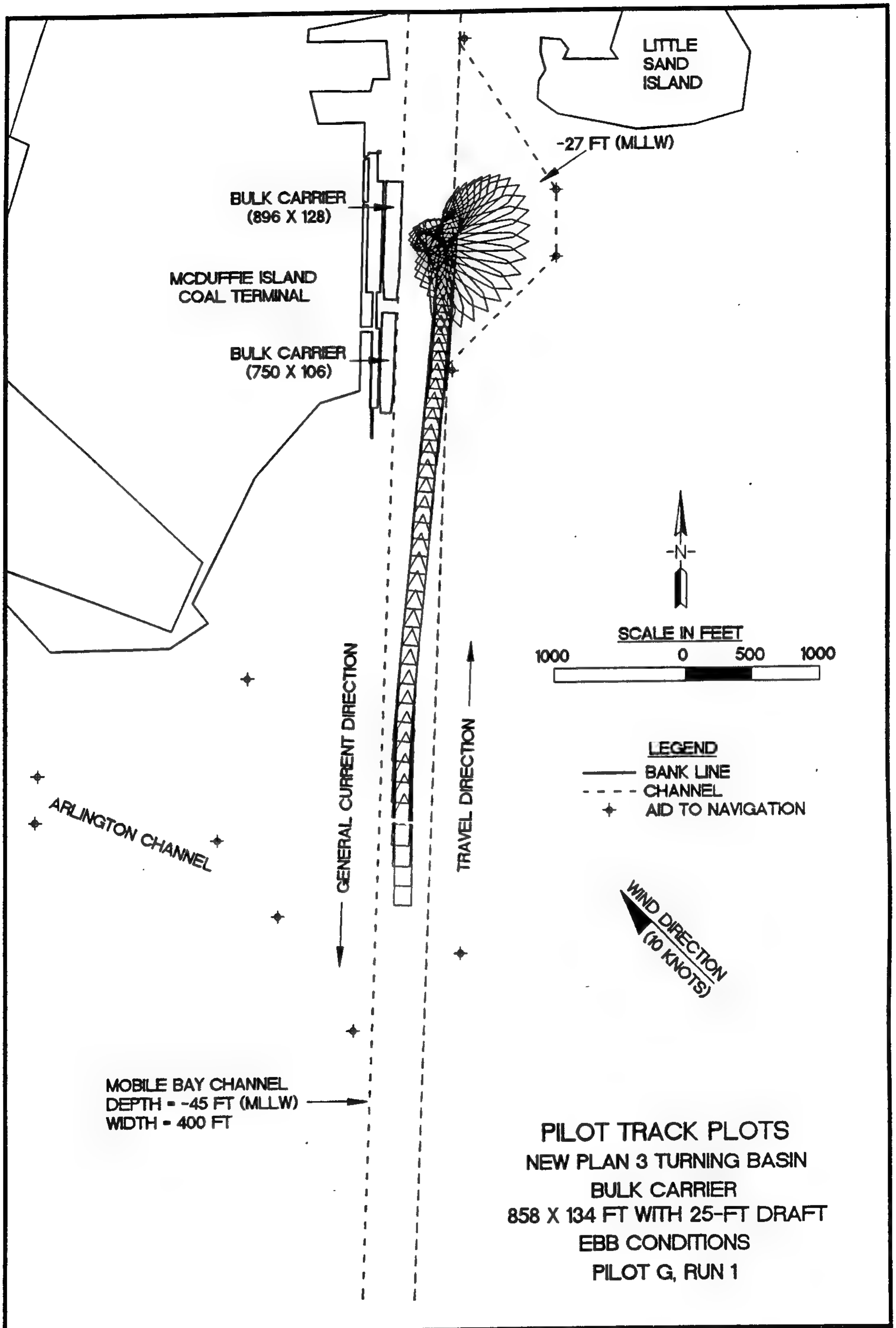


PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT J, RUN 2

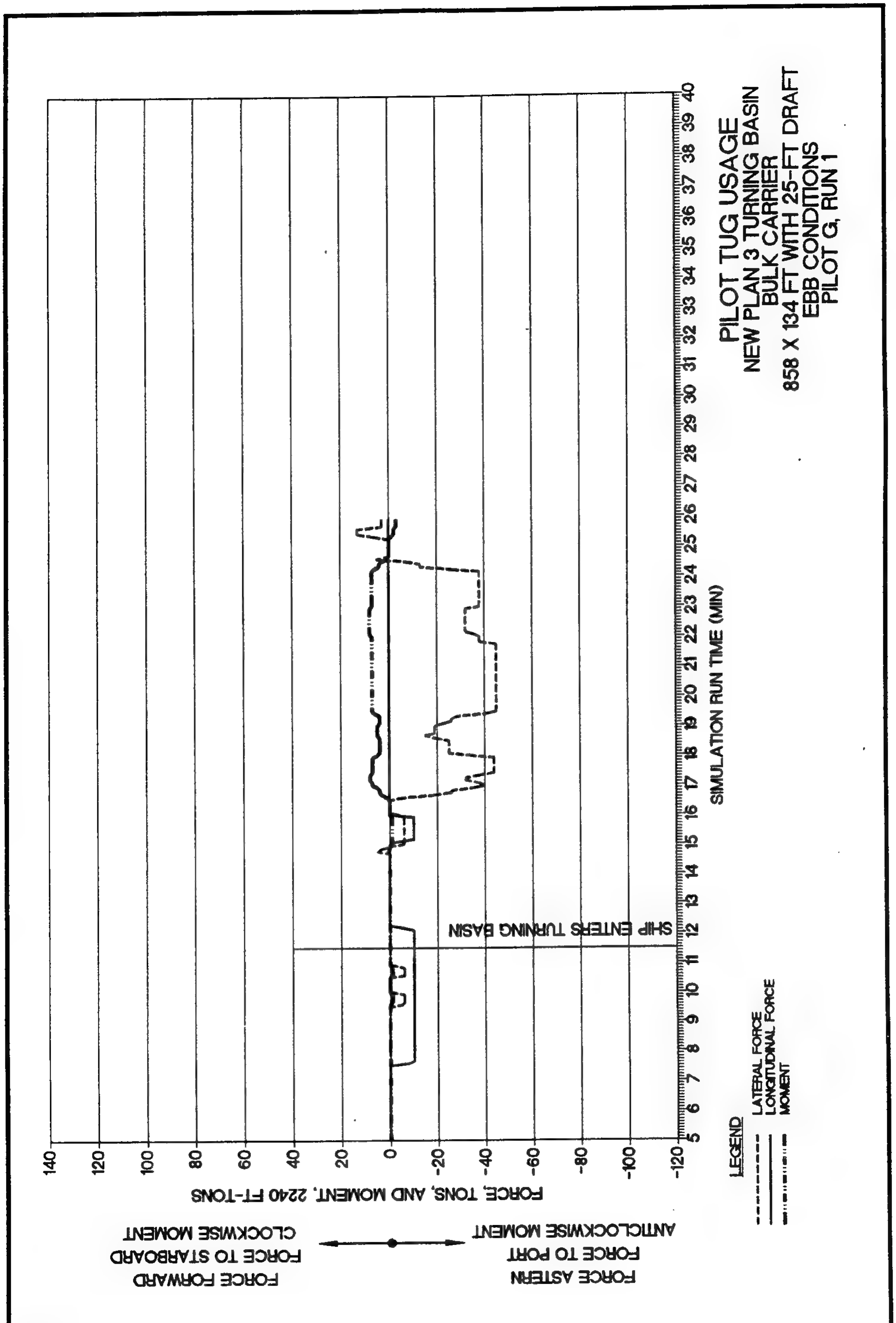


PILOT TUG USAGE
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT J, RUN 2

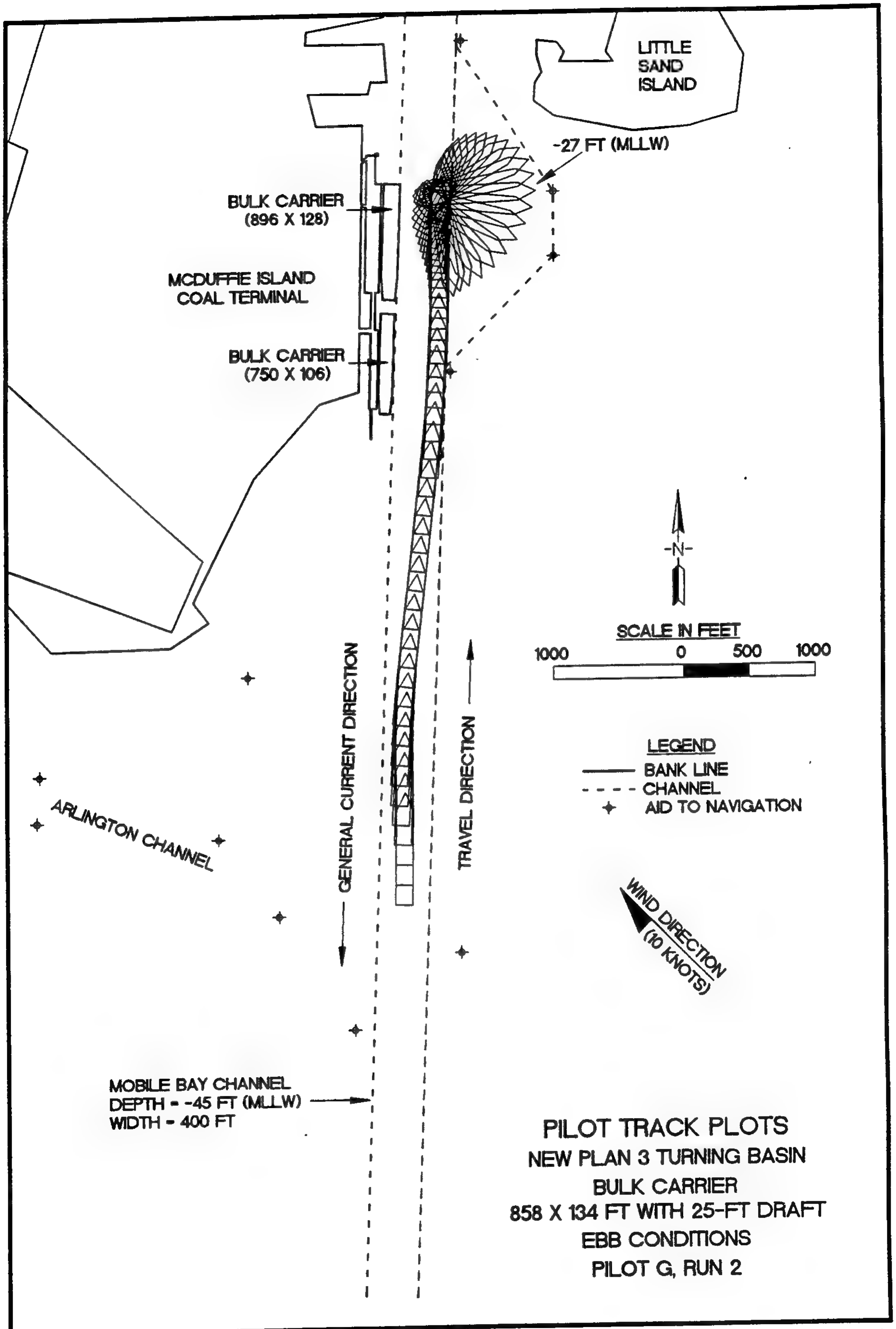
New Plan 3 Results

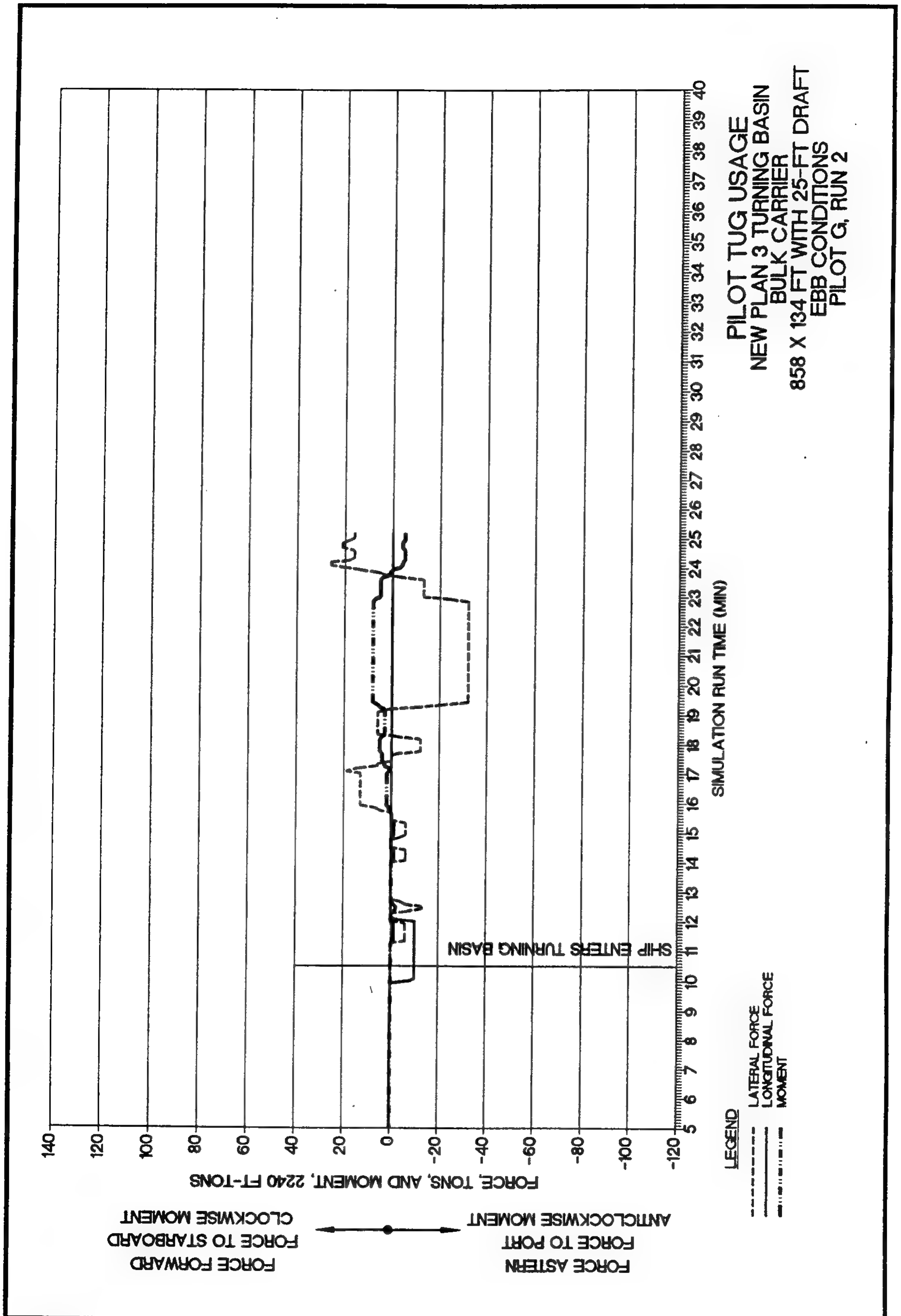


LITTLE SAND ISLAND
-27 FT (MLLW)
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
SCALE IN FEET
1000 0 500 1000
-N-
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT G, RUN 1



PILOT TUG USAGE
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT G, RUN 1
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
SHIP ENTERS TURNING BASIN
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40


LITTLE
SAND
ISLAND
-27 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT G, RUN 2



PILOT TUG USAGE
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT G, RUN 2
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
SHIP ENTERS TURNING BASIN
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT

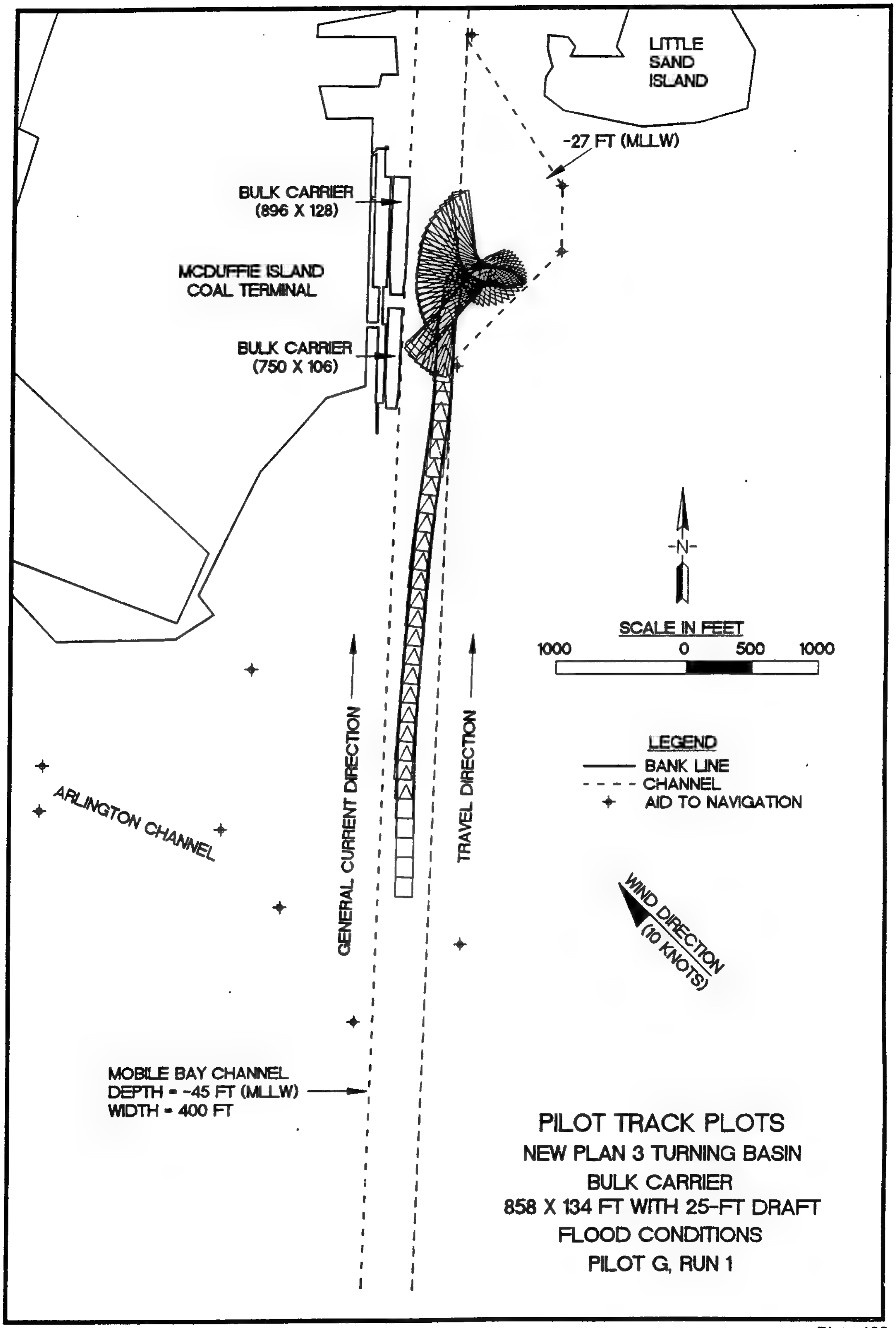
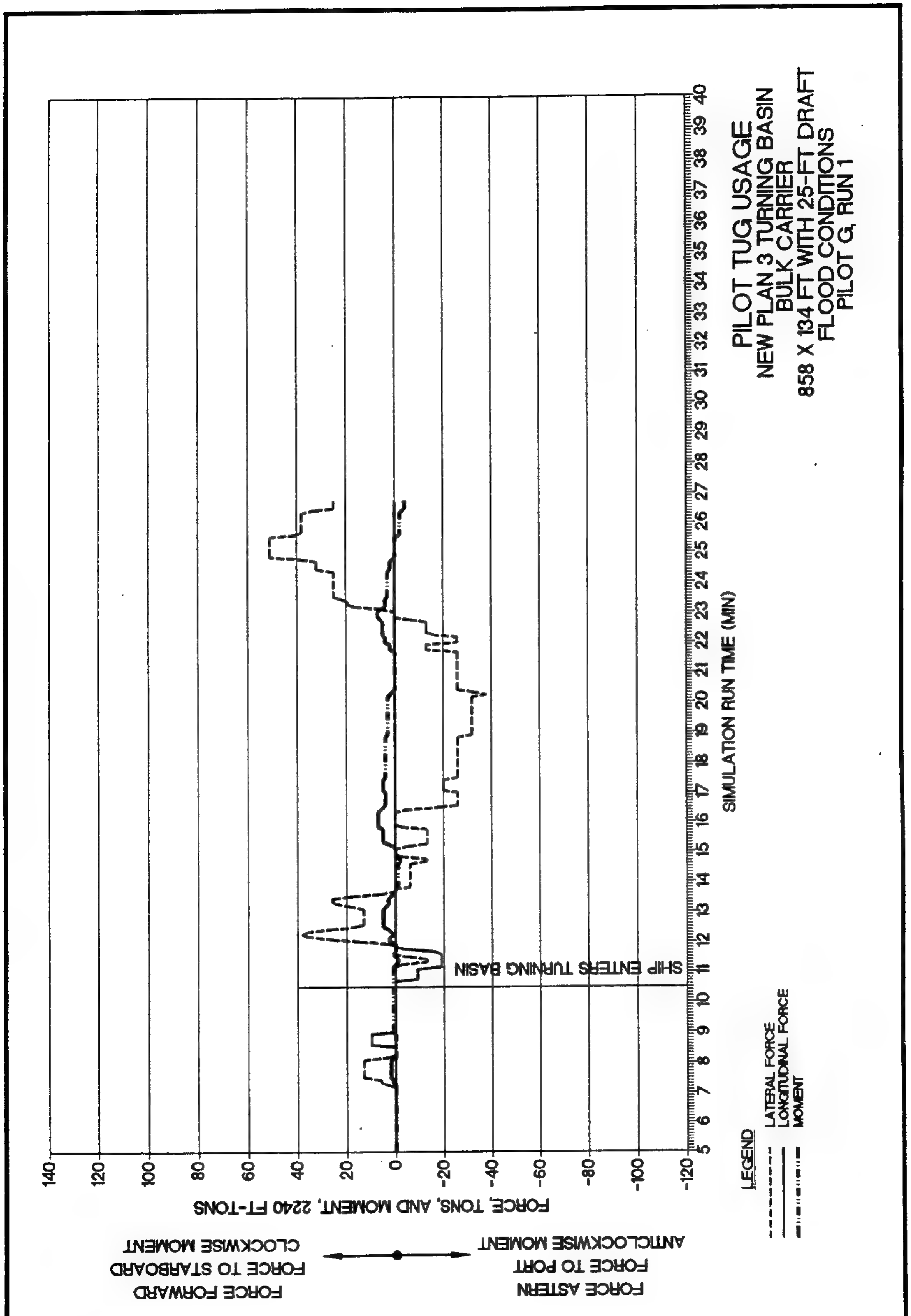
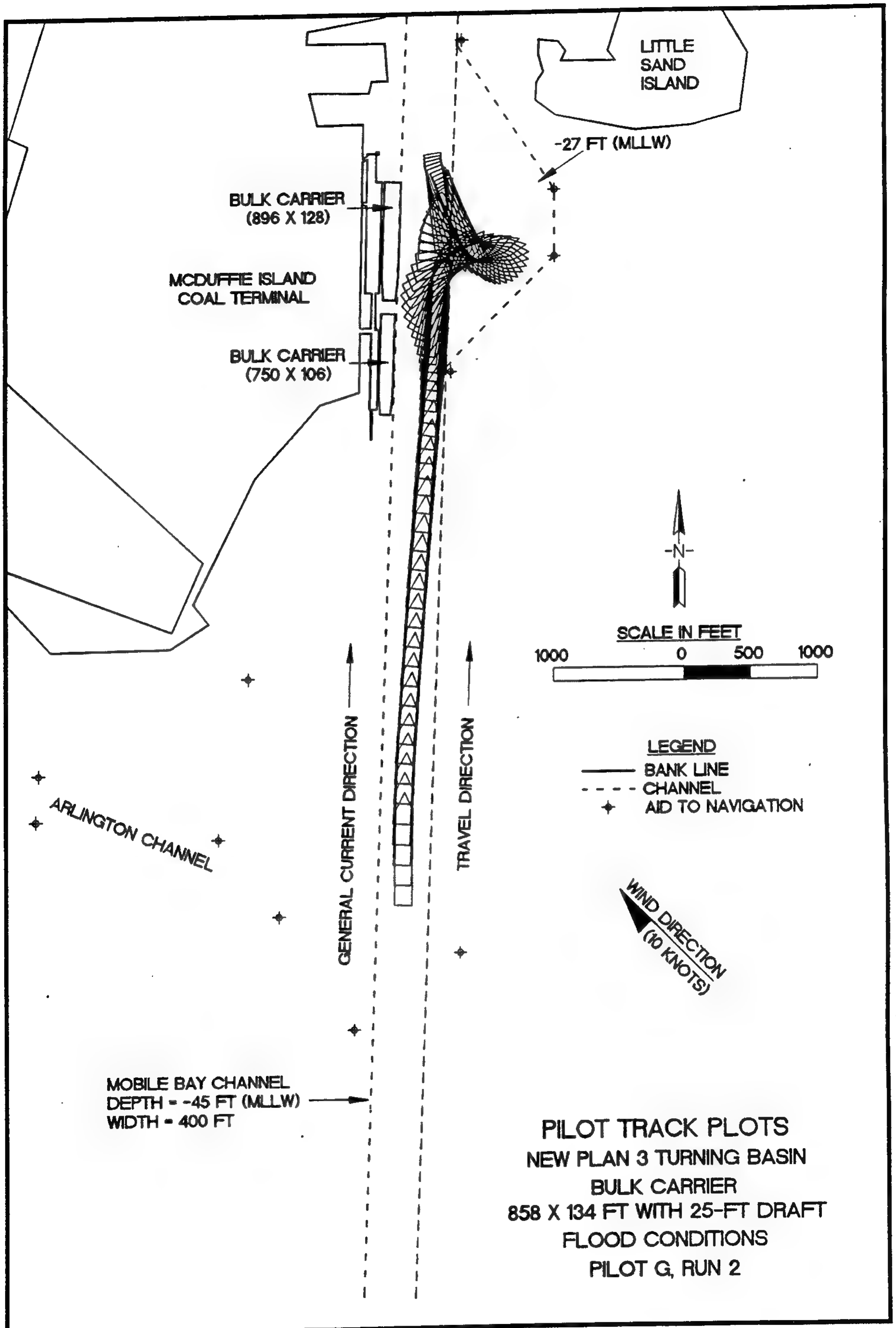
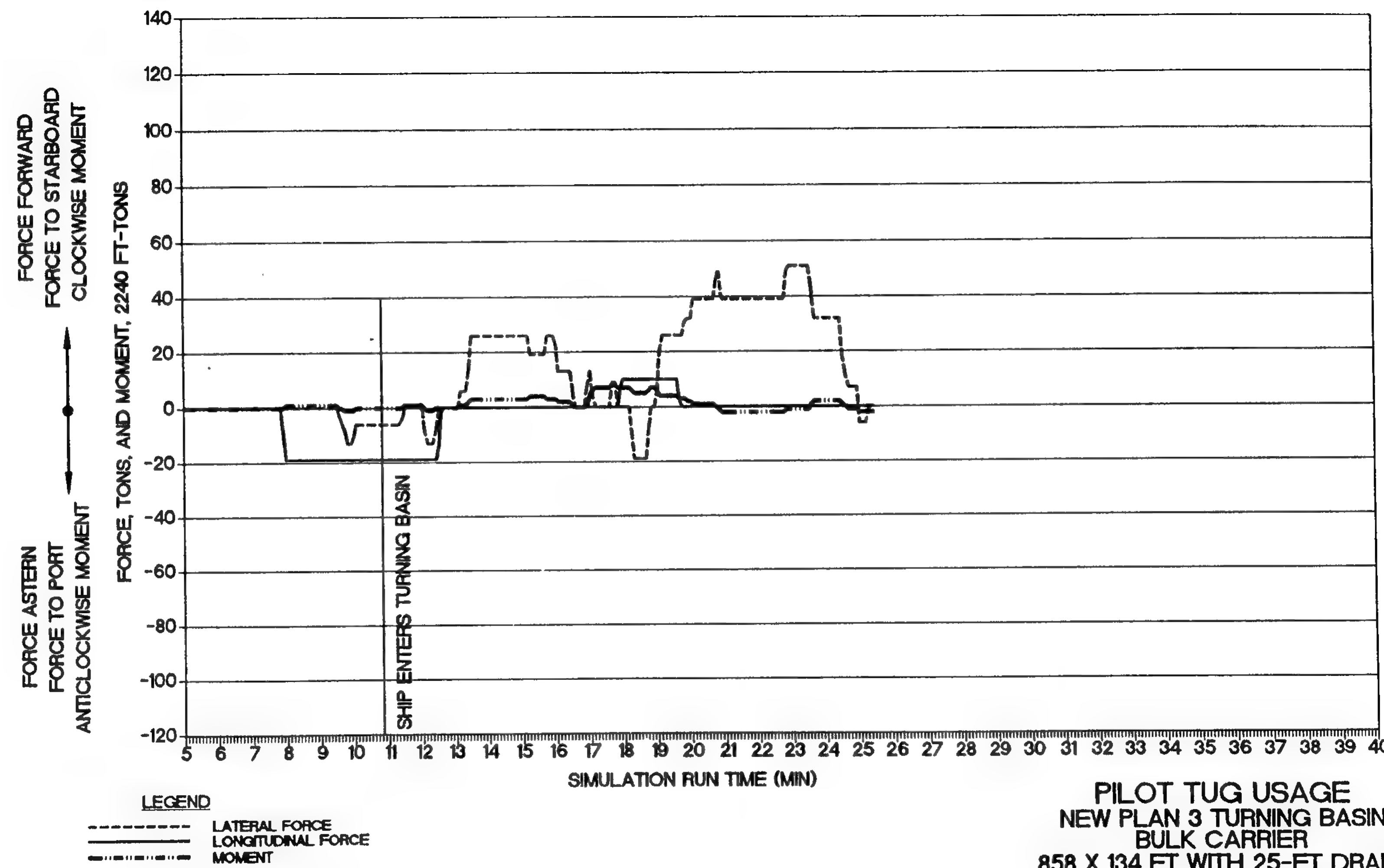

LITTLE
SAND
ISLAND
-27 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
SCALE IN FEET
1000
0
500
1000
-N-
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT G, RUN 1

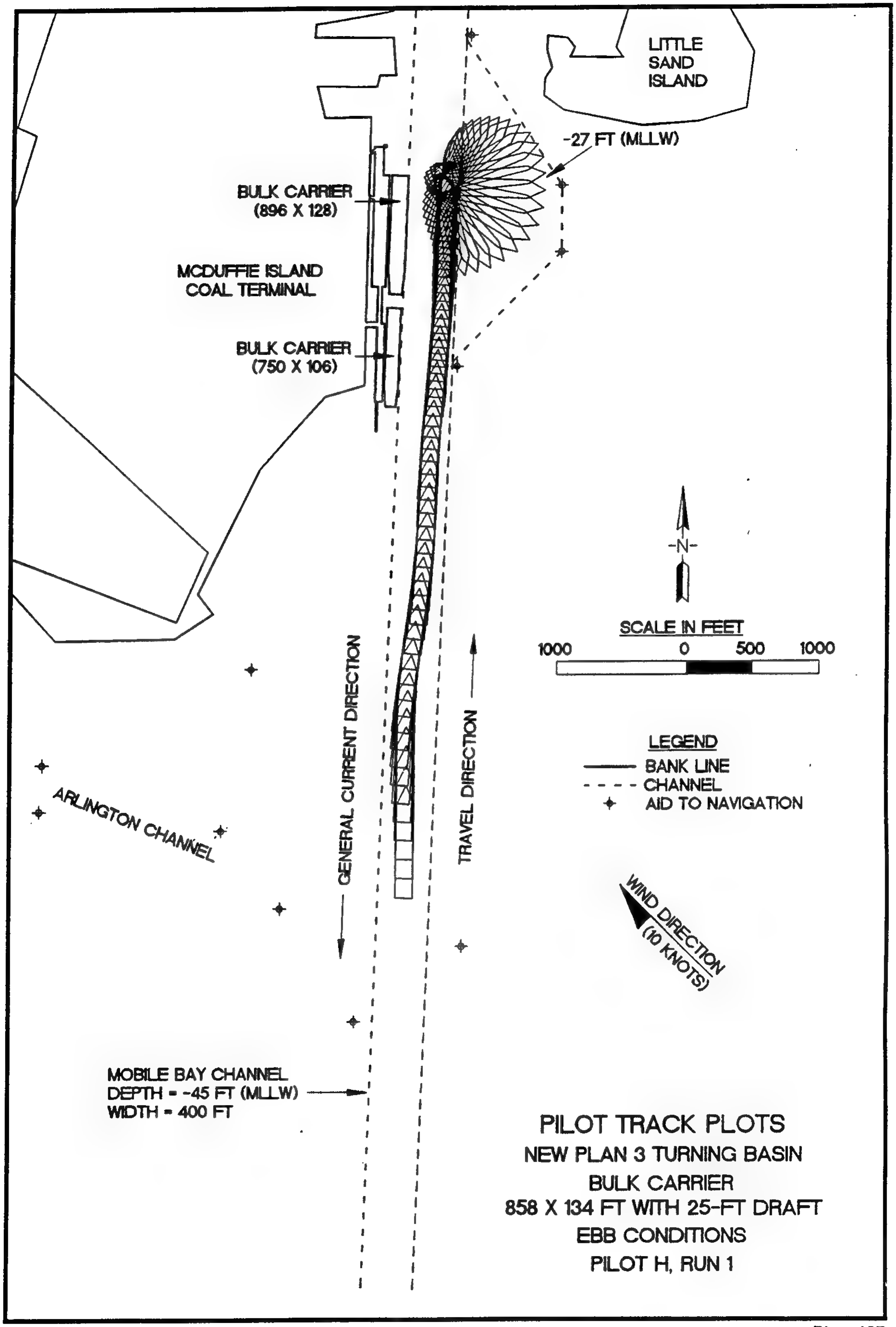
Plate 183


PILOT TUG USAGE
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT G, RUN 1
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
SHIP ENTERS TURNING BASIN
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT

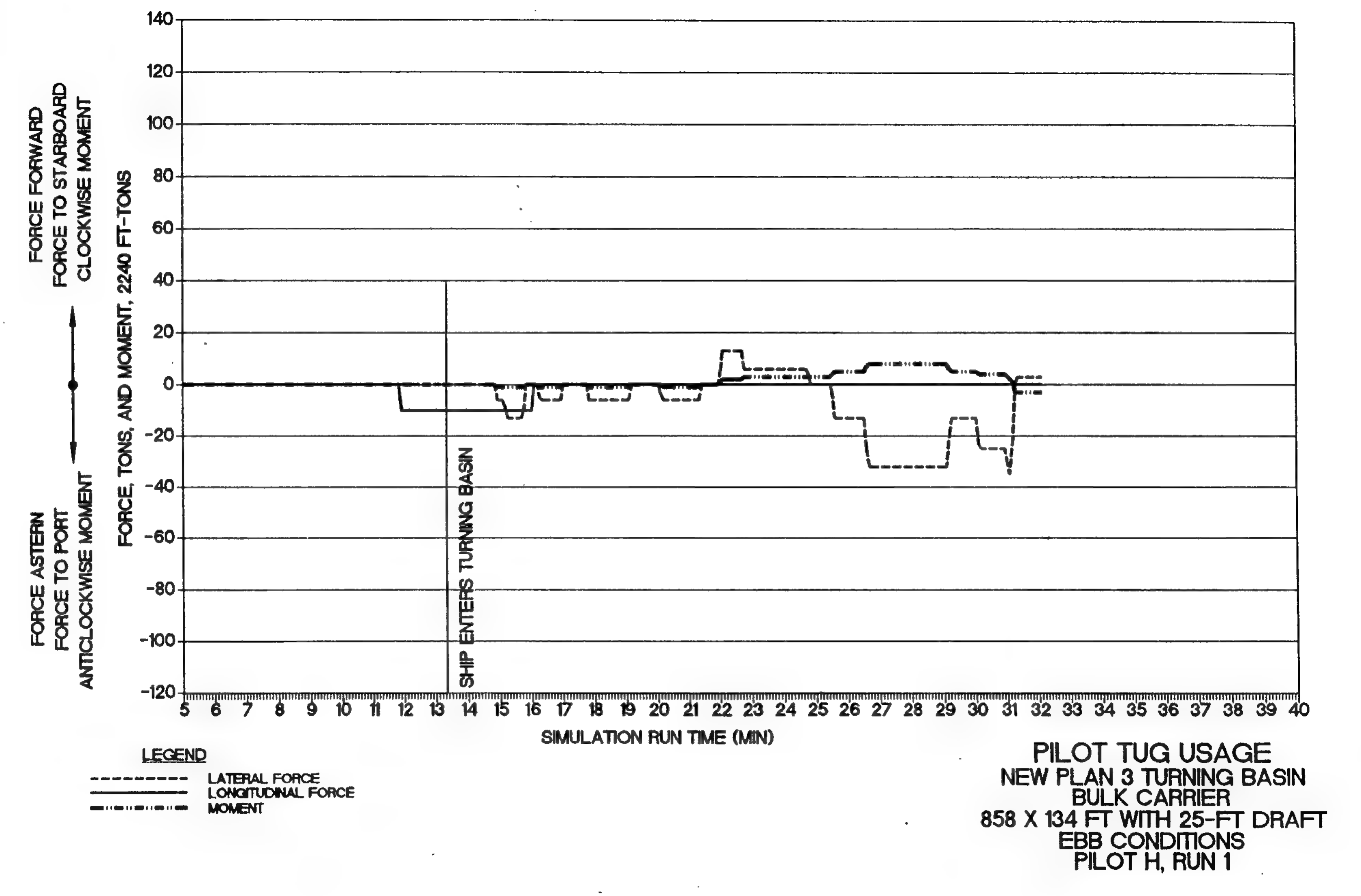

LITTLE SAND ISLAND
-27 FT (MLLW)
BULK CARRIER (896 X 128)
MCDUFFIE ISLAND COAL TERMINAL
BULK CARRIER (750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT G, RUN 2



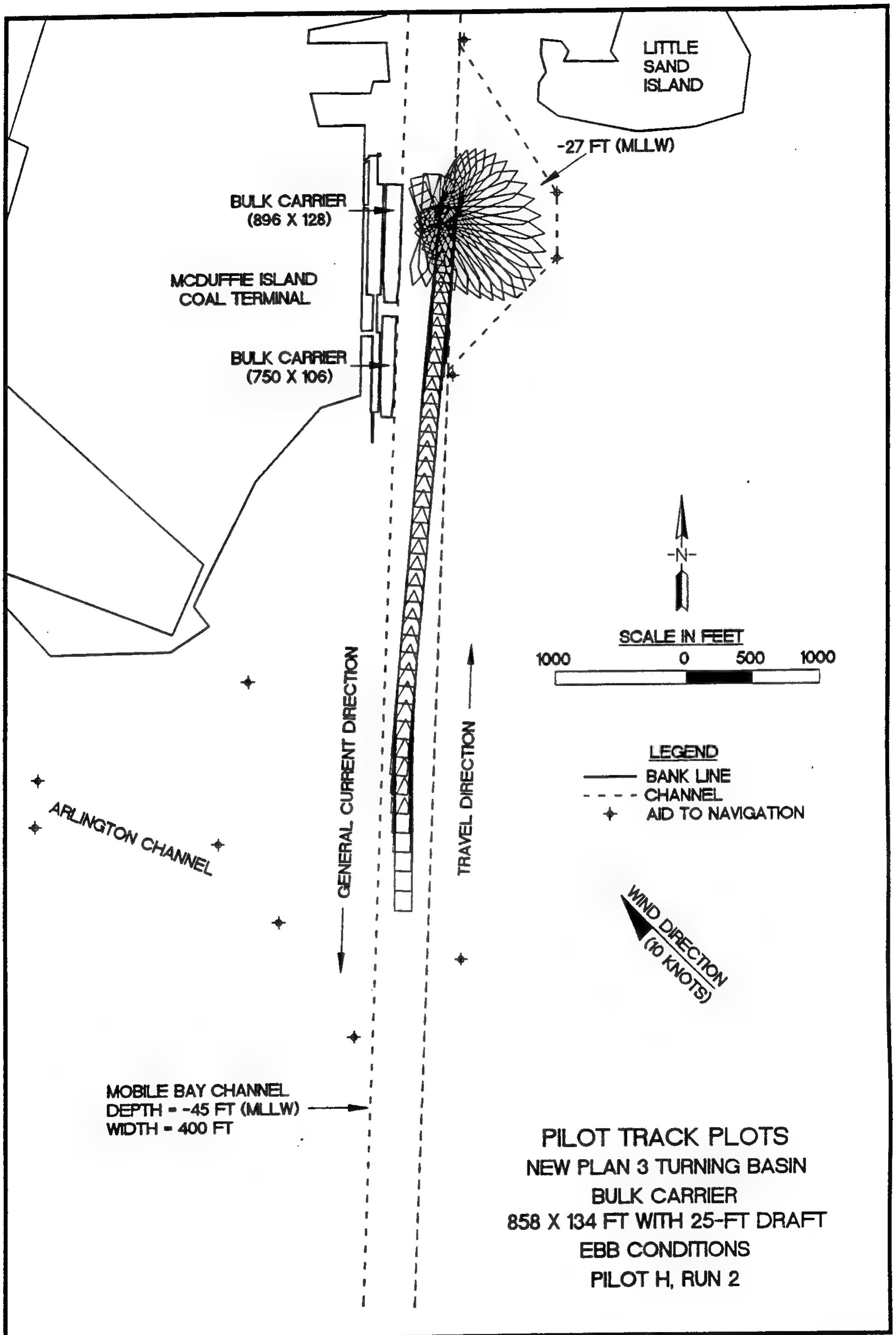
PILOT TUG USAGE
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT G, RUN 2

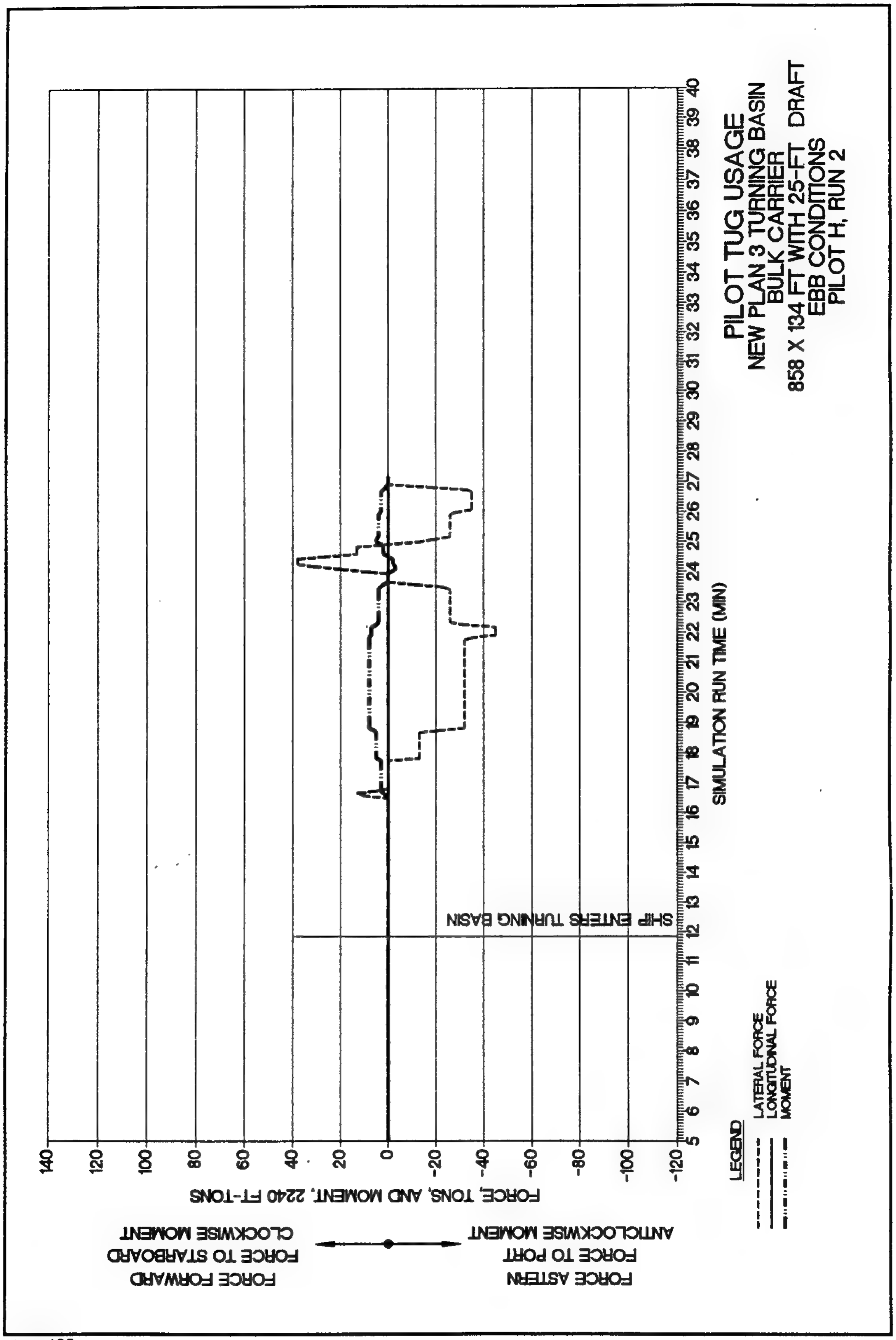


LITTLE
SAND
ISLAND
-27 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT H, RUN 1



FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE, TONS, AND MOMENT, 2240 FT-TONS
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
SIMULATION RUN TIME (MIN)
SHIP ENTERS TURNING BASIN
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT
PILOT TUG USAGE
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT H, RUN 1


LITTLE
SAND
ISLAND
-27 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
N
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT H, RUN 2


PILOT TUG USAGE
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT H, RUN 2
FORCE, TONS, AND MOMENT, 2240 FT-TONS
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
SIMULATION RUN TIME (MIN)
5
6
7
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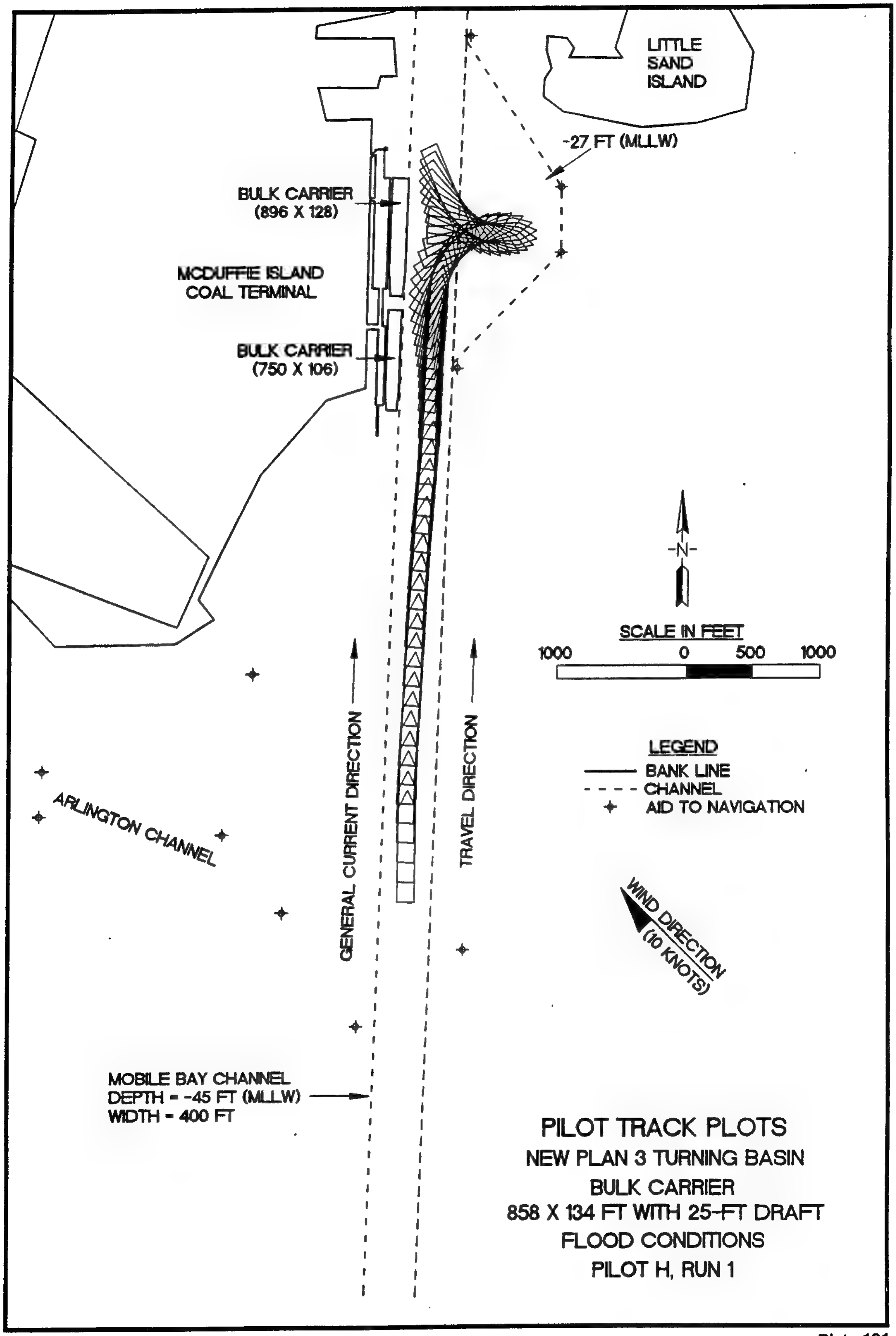
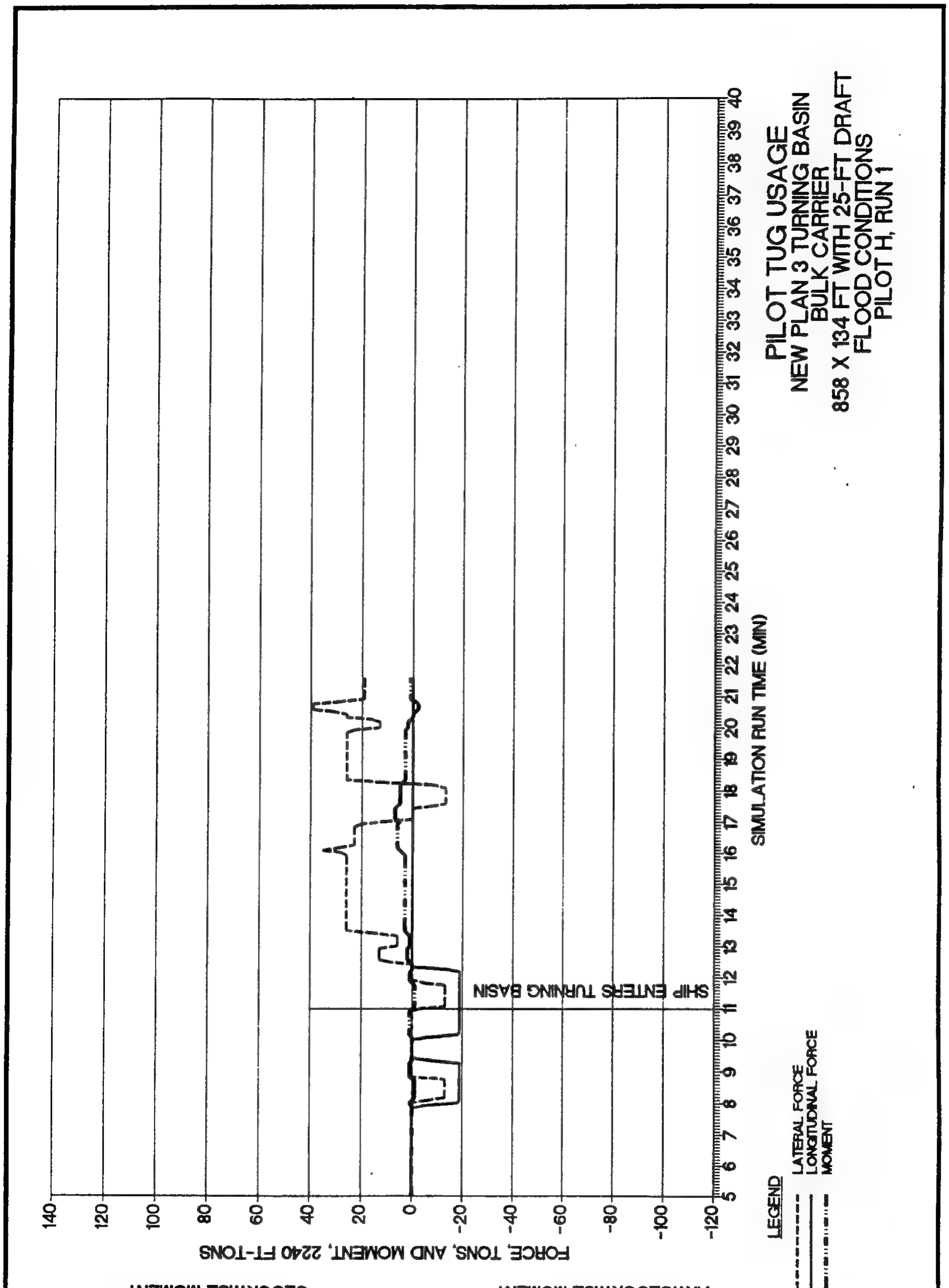
39
40
SHIP ENTERS TURNING BASIN
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT


LITTLE
SAND
ISLAND
-27 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000
0
500
1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT H, RUN 1


PILOT TUG USAGE
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT H, RUN 1
SIMULATION RUN TIME (MIN)
FORCE, TONS, AND MOMENT, 2240 FT-TONS
SHIP ENTERS TURNING BASIN
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT
140
120
100
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0
-20
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-80
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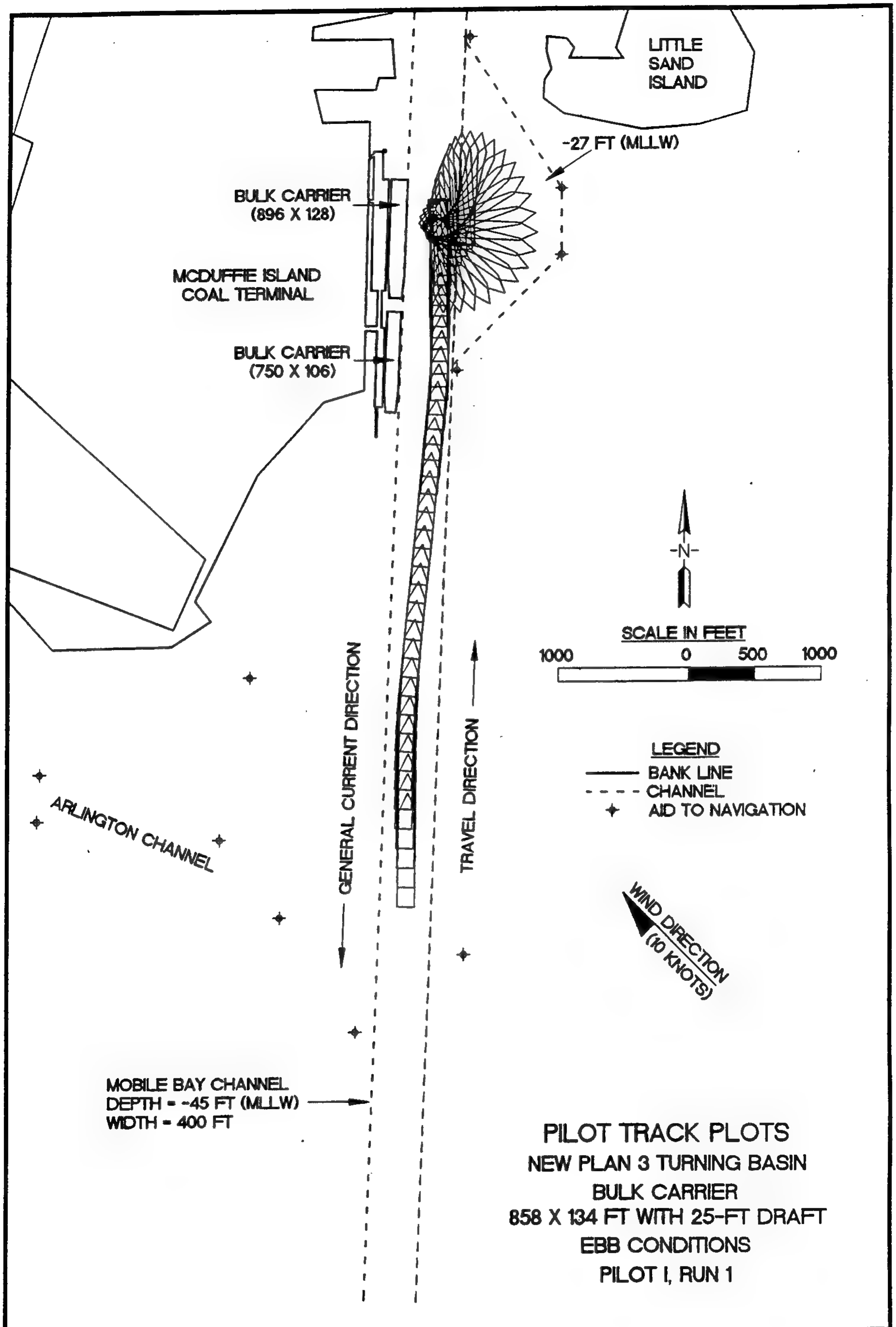
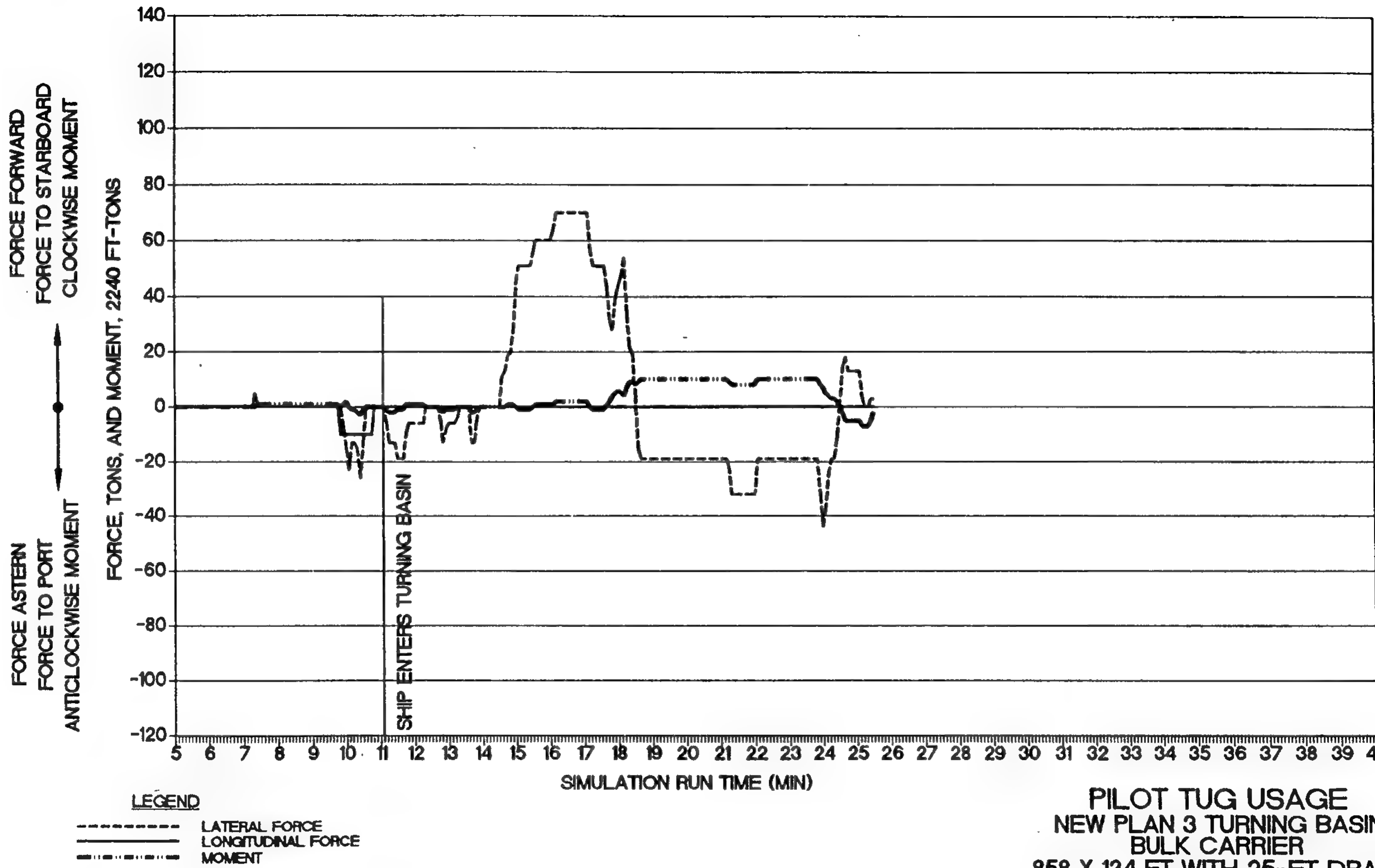
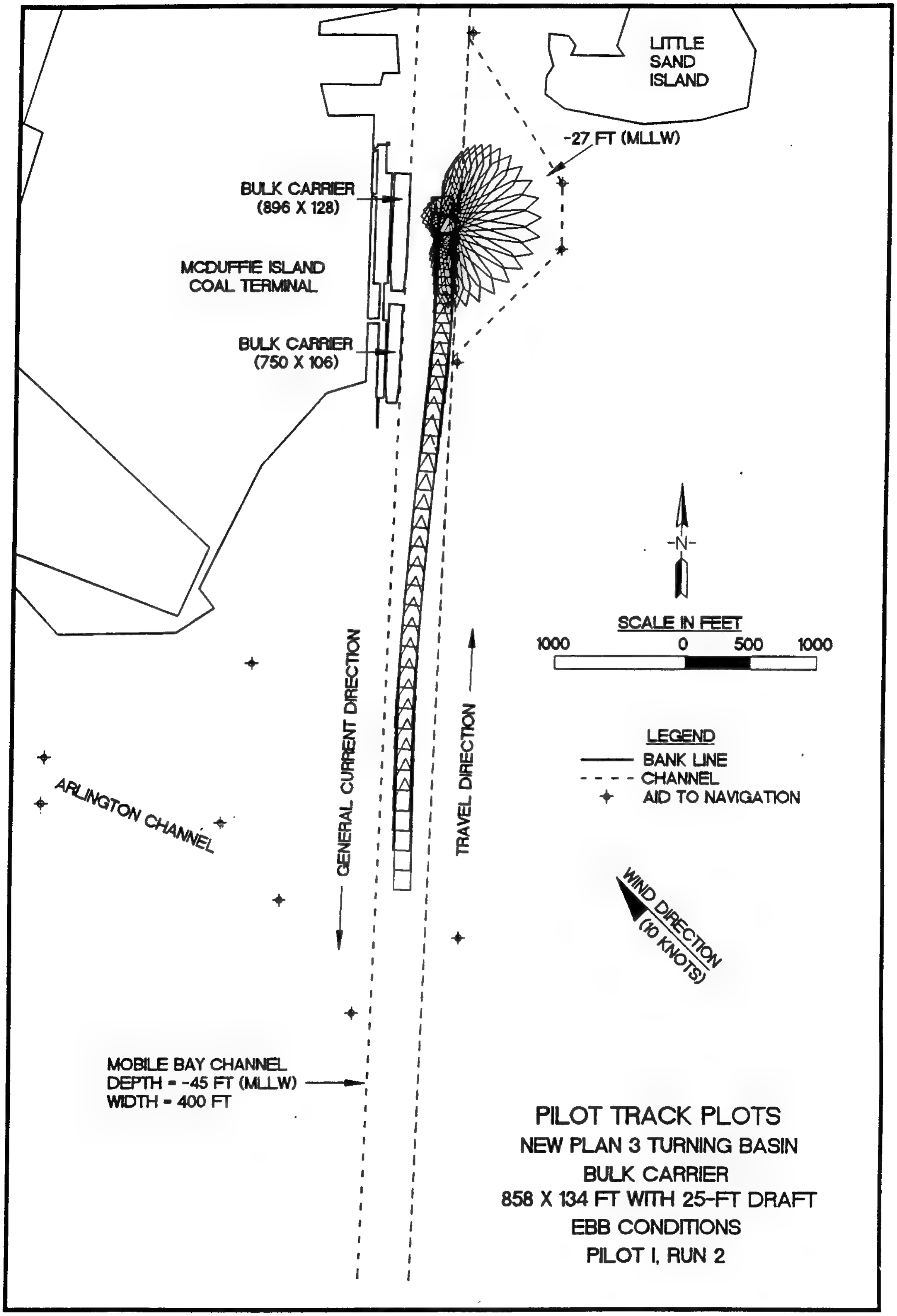
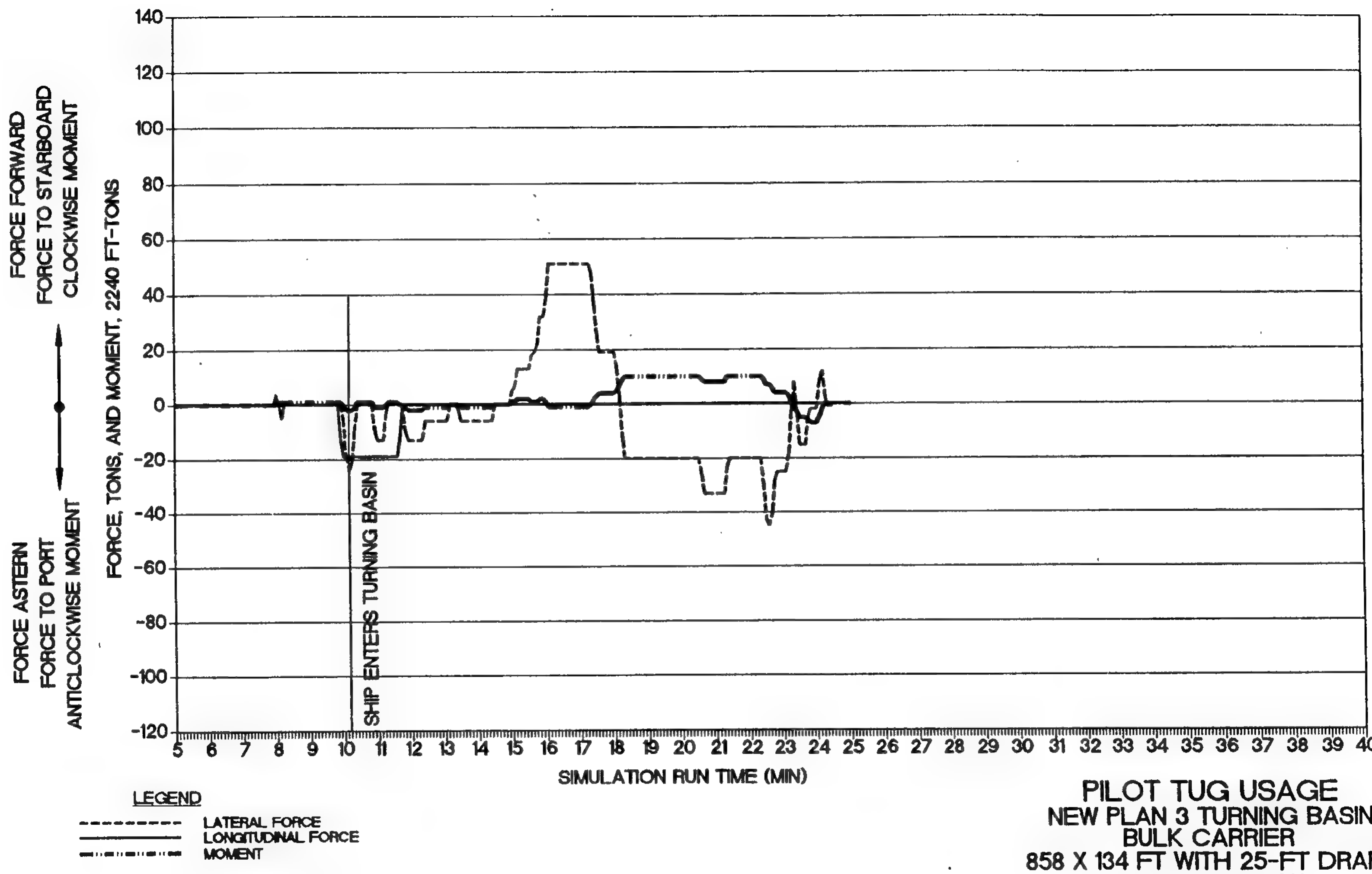

LITTLE
SAND
ISLAND
-27 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT I, RUN 1

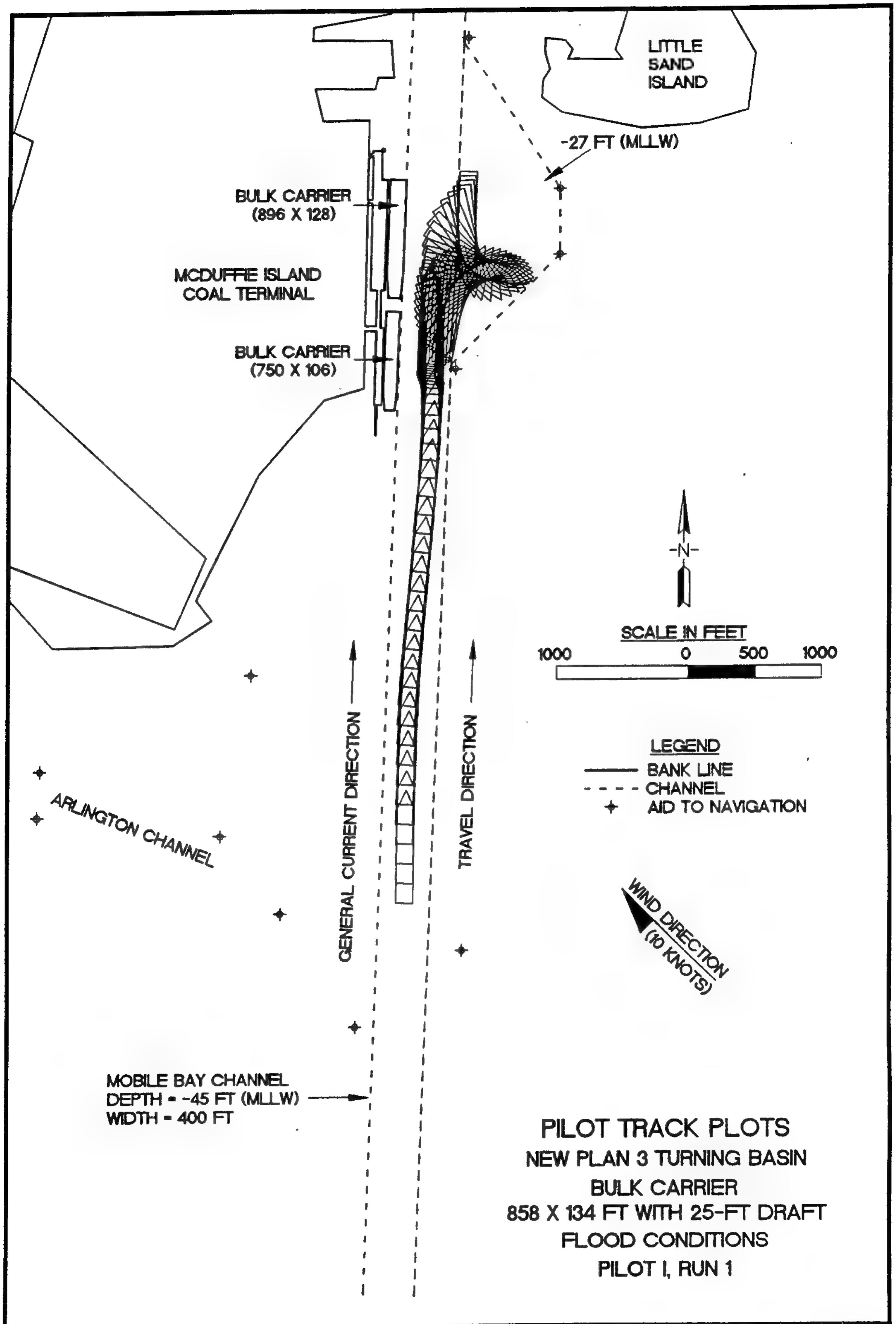


PILOT TUG USAGE
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT I, RUN 1

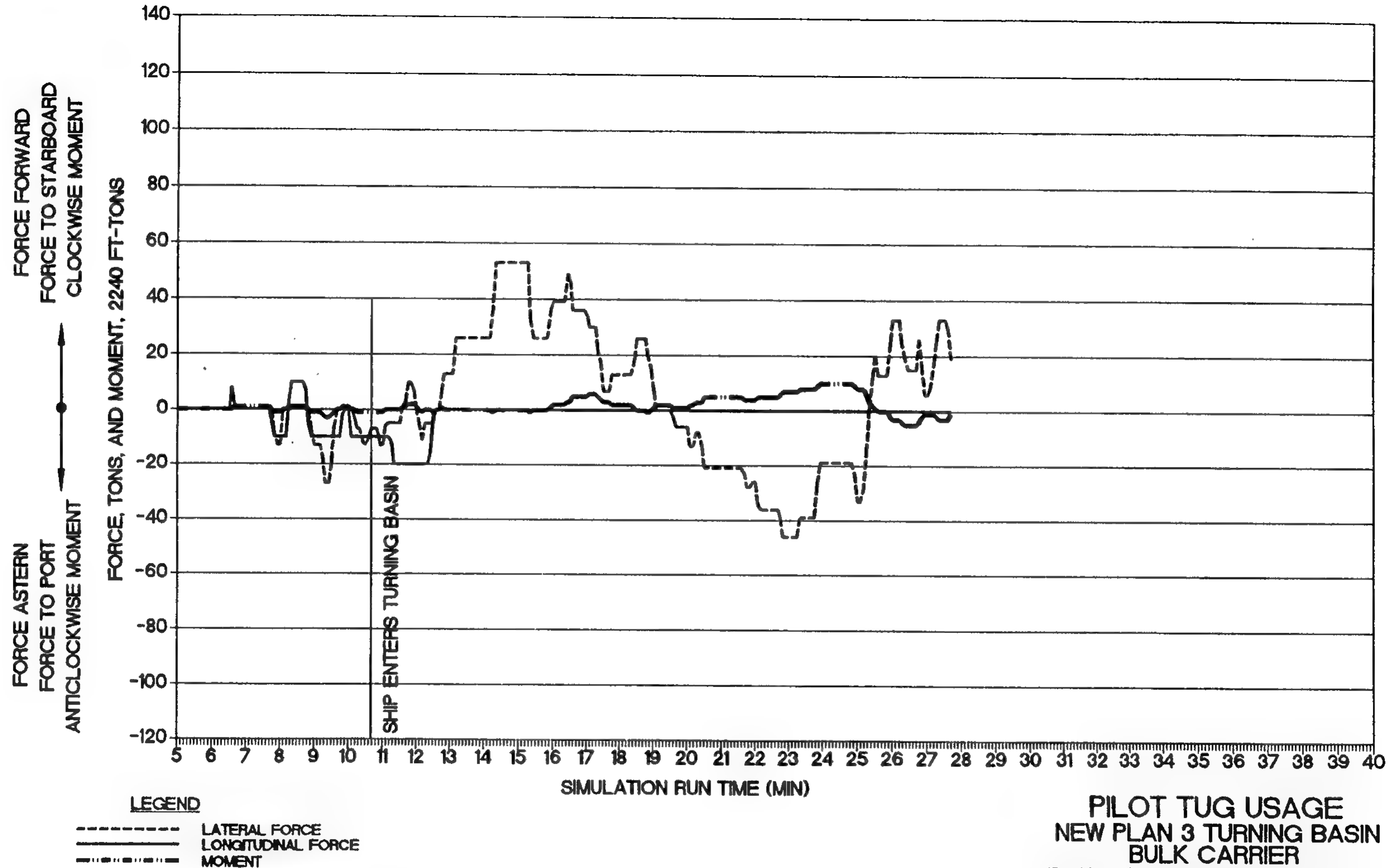

LITTLE
SAND
ISLAND
-27 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT I, RUN 2



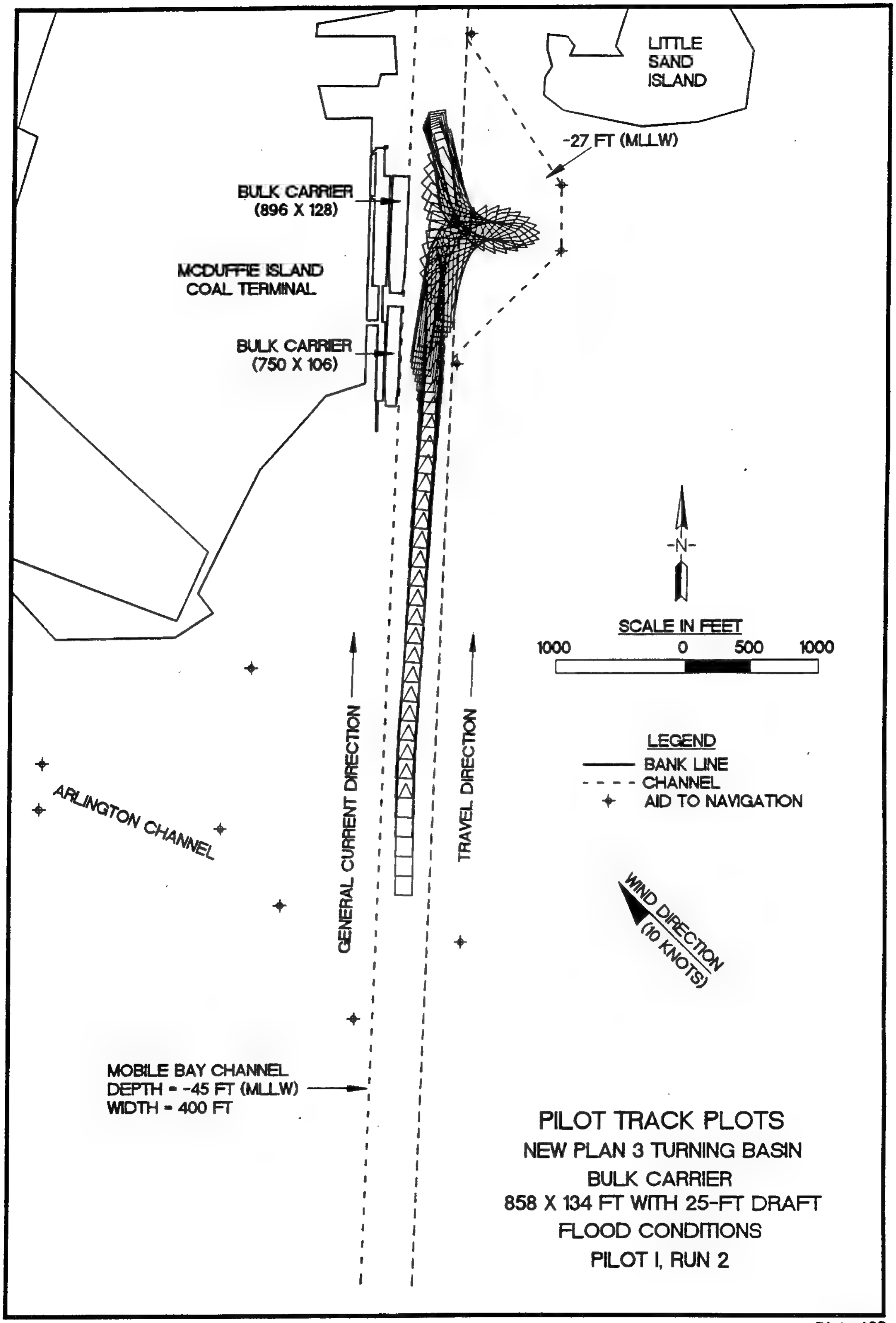
PILOT TUG USAGE
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT I, RUN 2

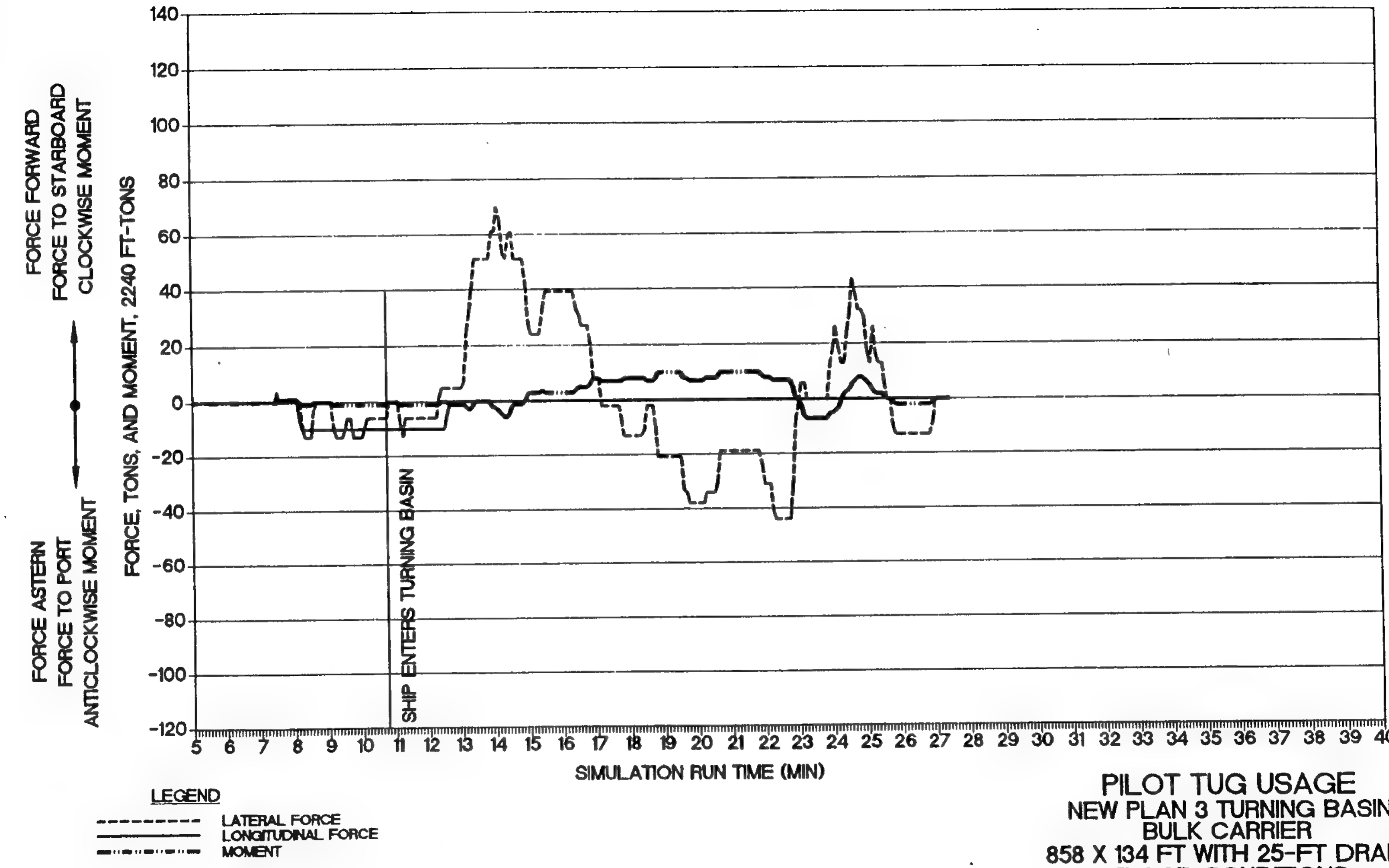


PILOT TRACK PLOTS
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT I, RUN 1

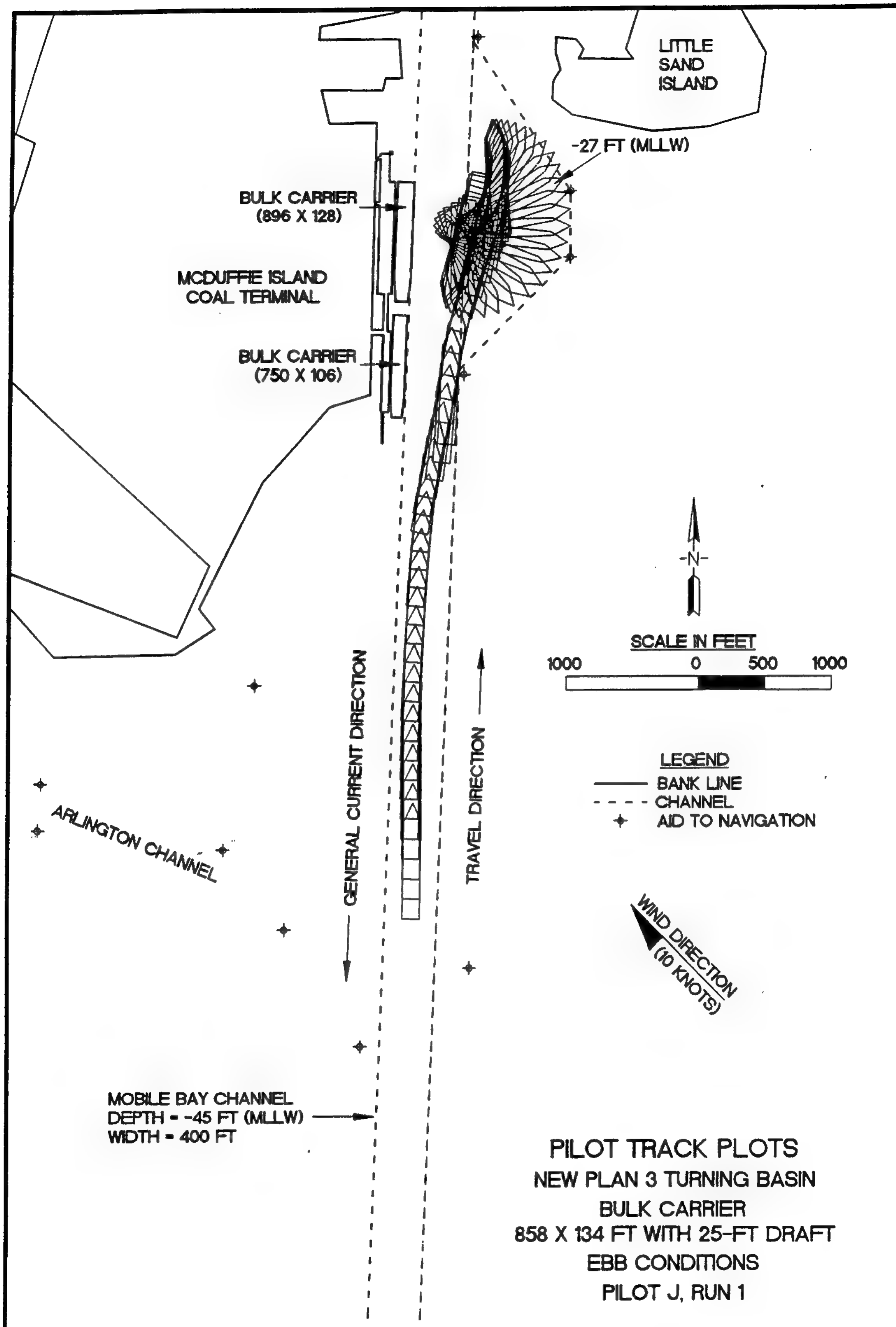


PILOT TUG USAGE
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT I, RUN 1

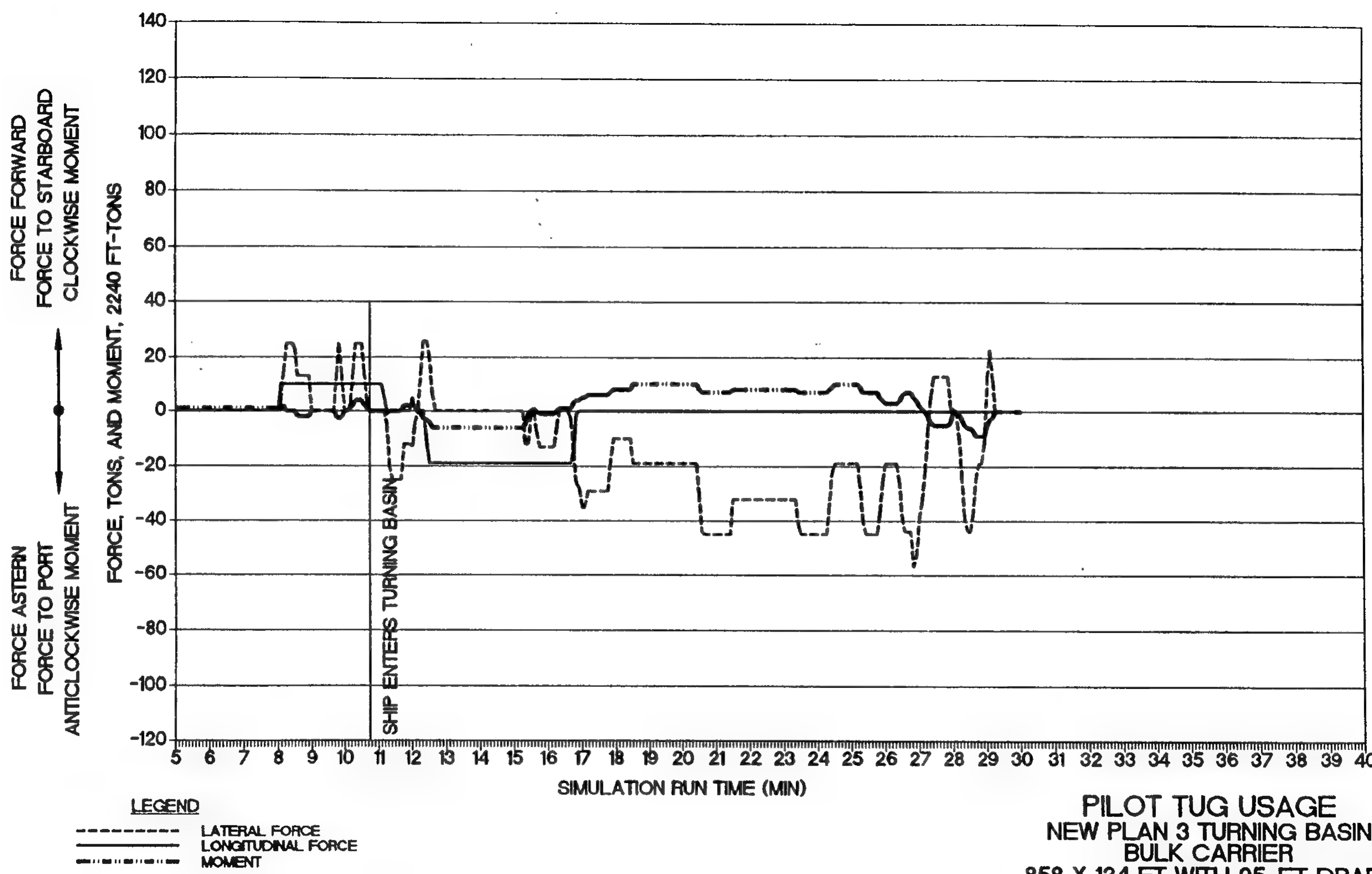

LITTLE
SAND
ISLAND
-27 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT I, RUN 2



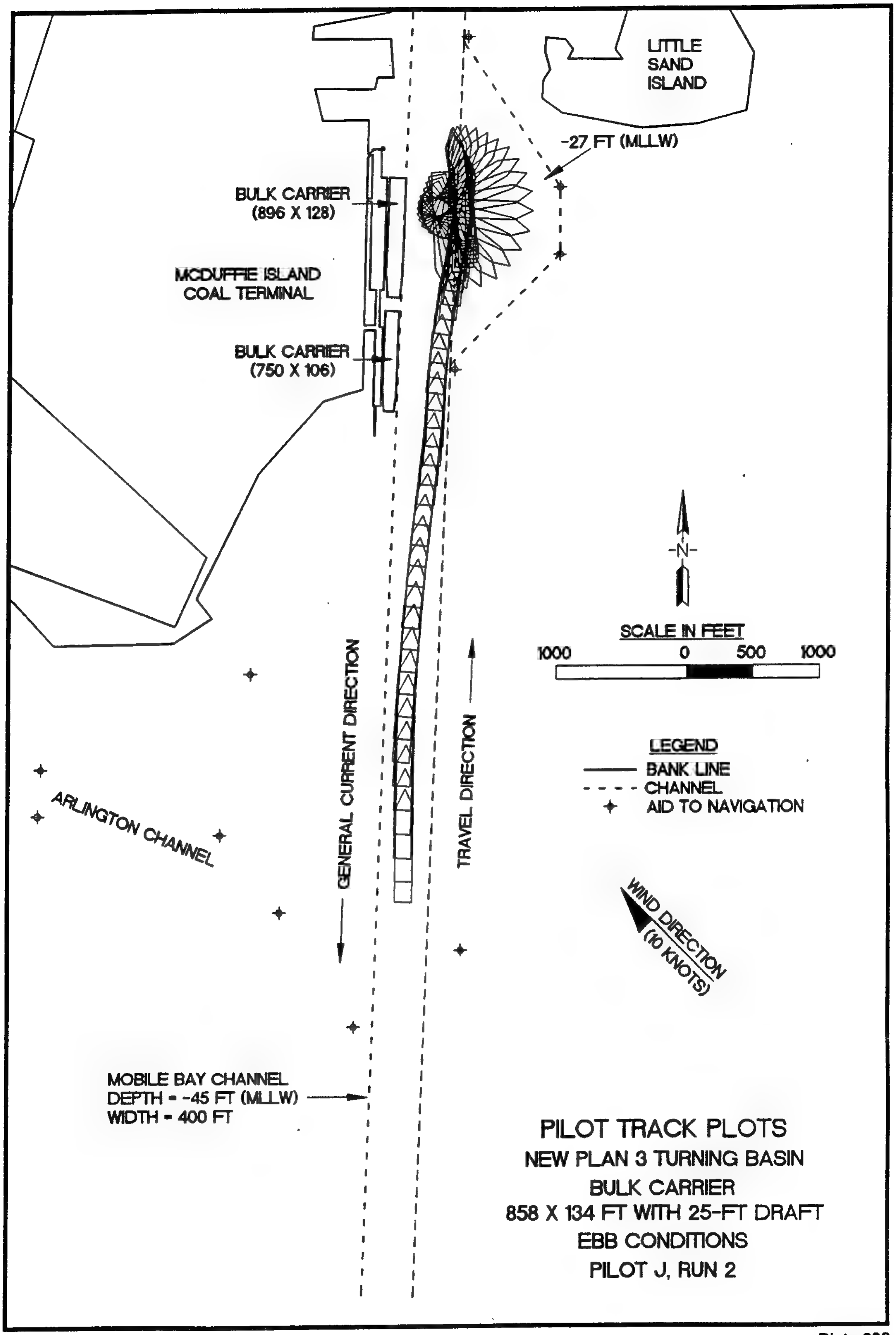
PILOT TUG USAGE
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT I, RUN 2



PILOT TRACK PLOTS
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT J, RUN 1



PILOT TUG USAGE
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT J, RUN 1


LITTLE SAND ISLAND
-27 FT (MLLW)
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BULK CARRIER (750 X 106)
SCALE IN FEET
1000 0 500 1000
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AID TO NAVIGATION
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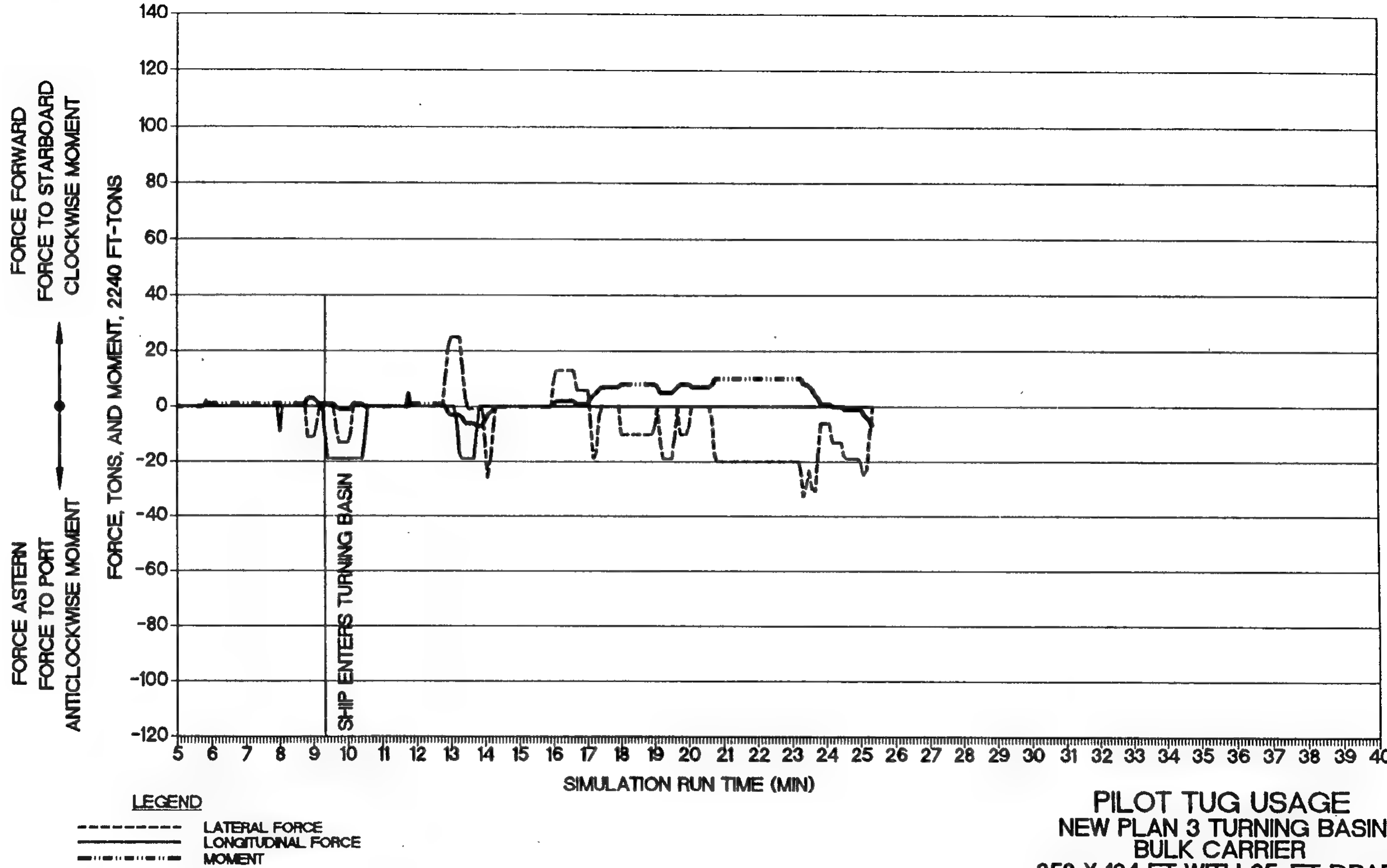
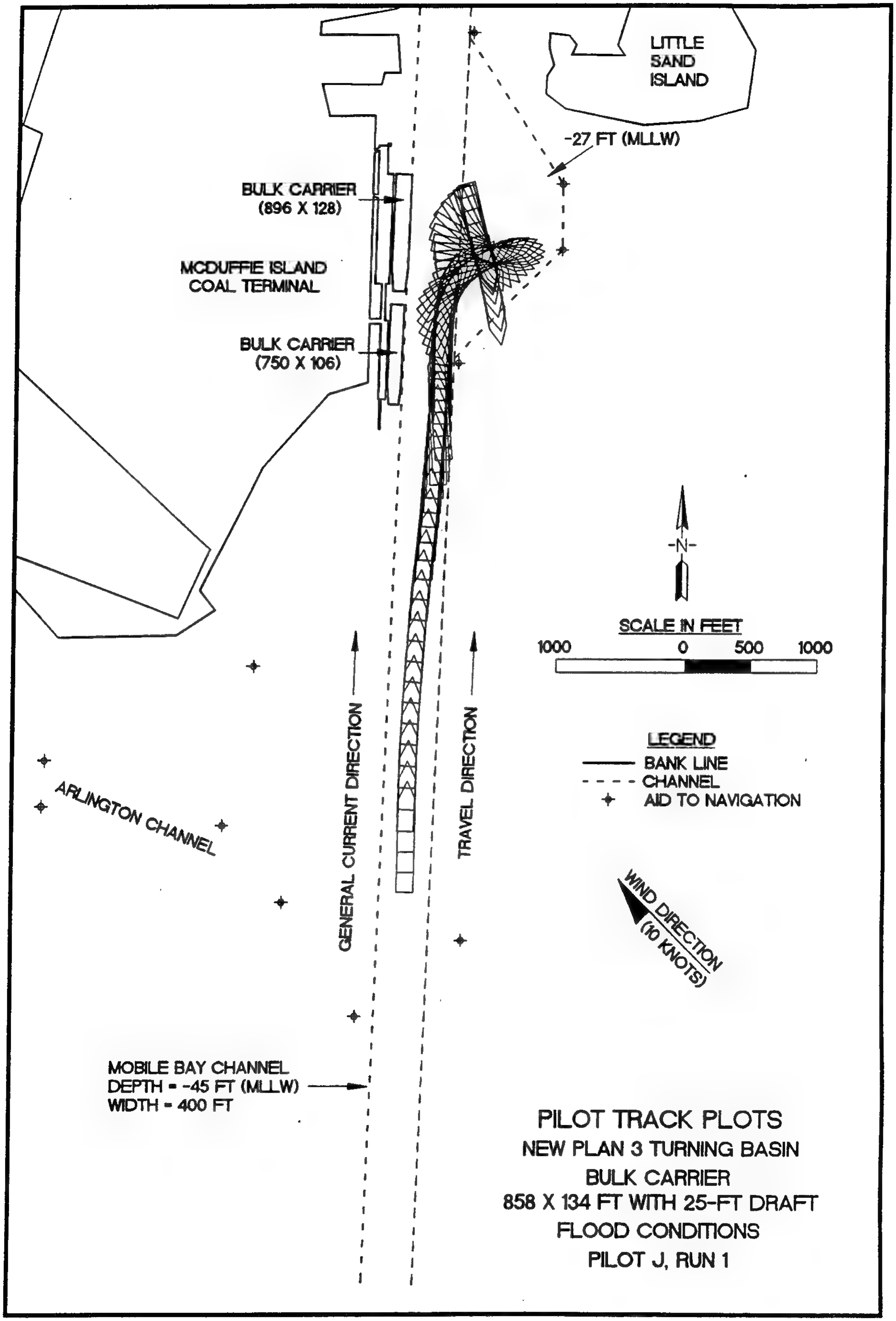
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
WIND DIRECTION (10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT J, RUN 2



PILOT TUG USAGE
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
PILOT J, RUN 2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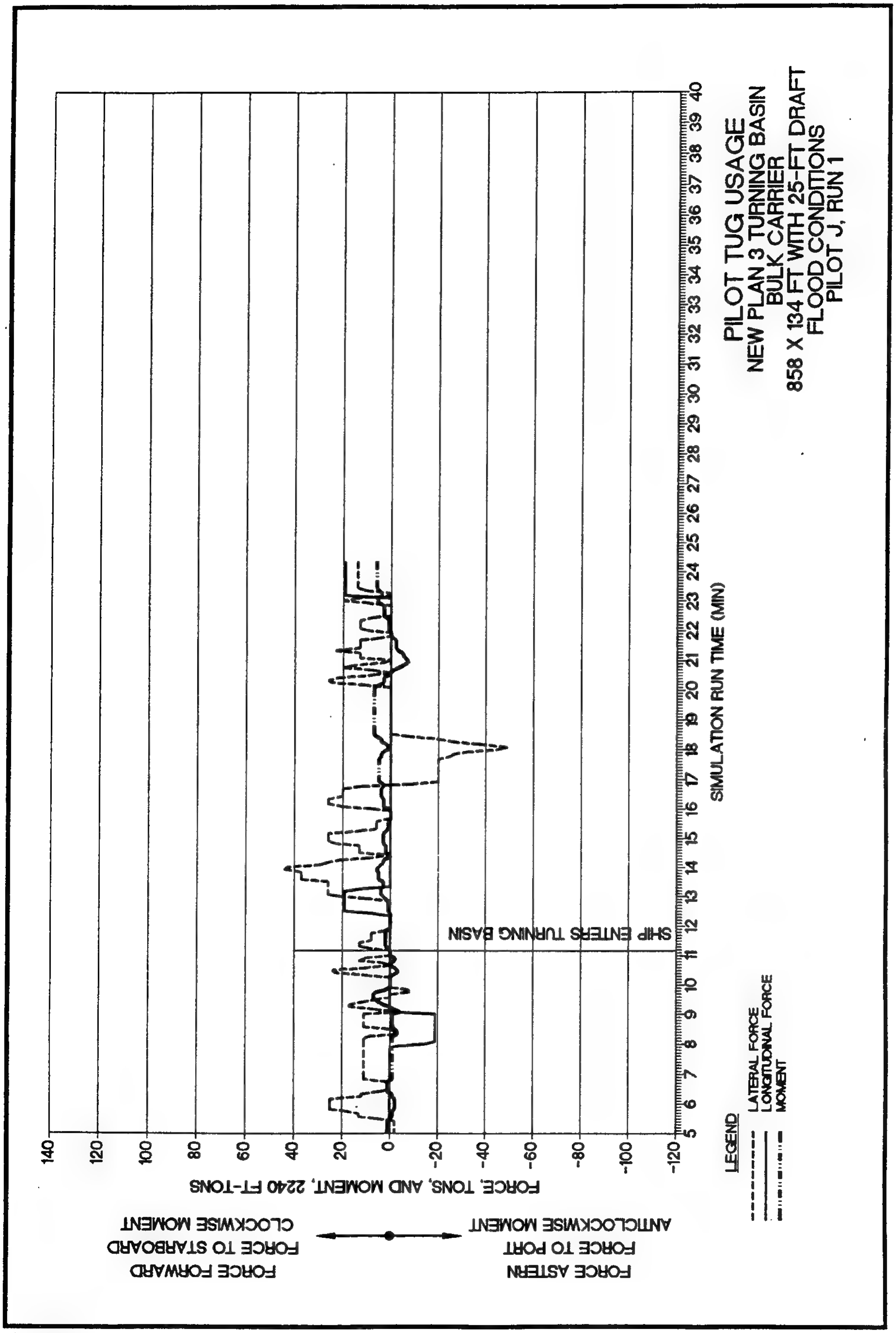
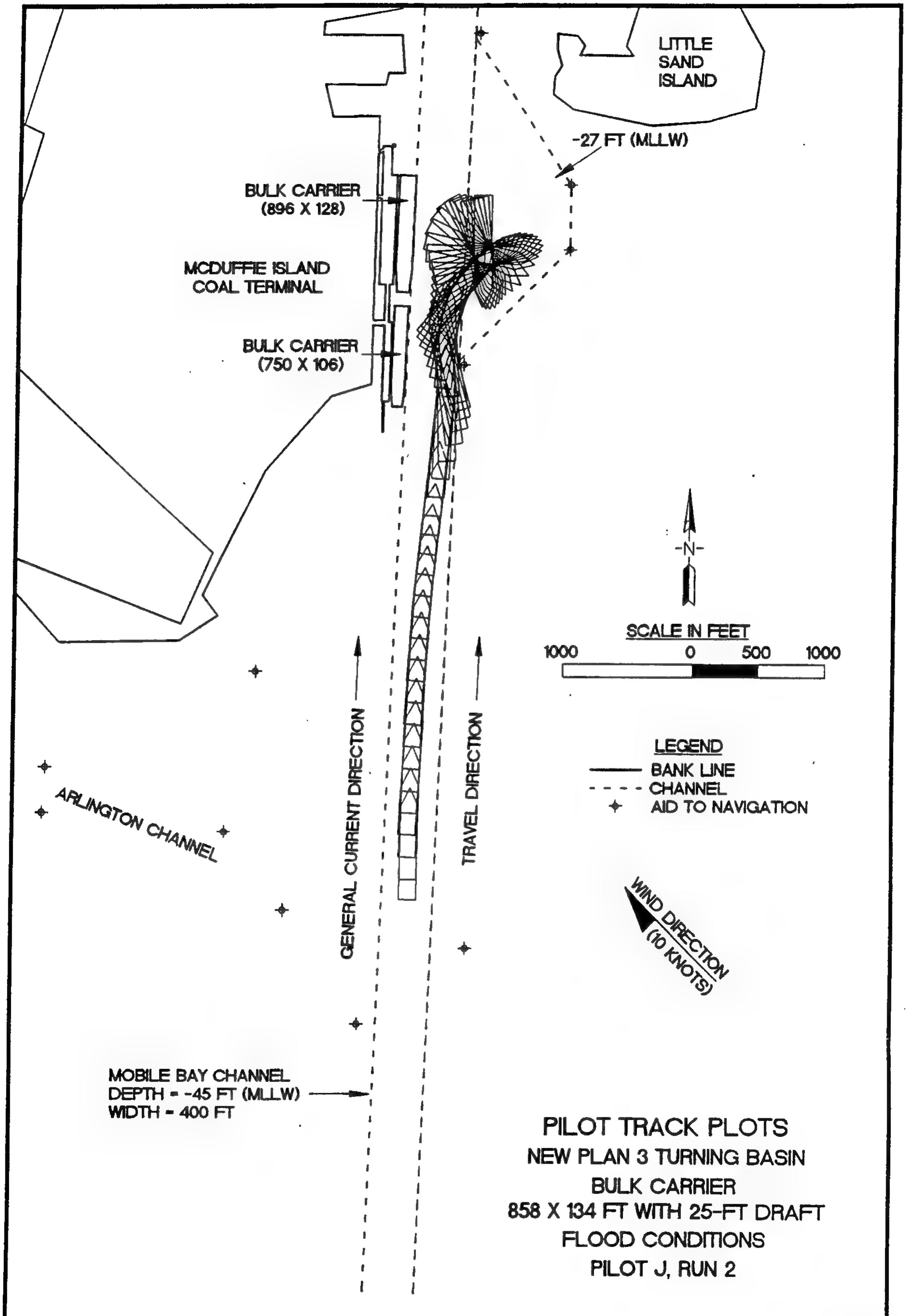
SAND
ISLAND
-27 FT (MLLW)
BULK CARRIER
(896 X 128)
MCDUFFIE ISLAND
COAL TERMINAL
BULK CARRIER
(750 X 106)
N
SCALE IN FEET
1000 0 500 1000
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT J, RUN 1



PILOT TUG USAGE
NEW PLAN 3 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT J, RUN 1
FORCE ASTERN
FORCE TO PORT
ANTICLOCKWISE MOMENT
FORCE FORWARD
FORCE TO STARBOARD
CLOCKWISE MOMENT
FORCE, TONS, AND MOMENT, 2240 FT-TONS
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
SIMULATION RUN TIME (MIN)
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
SHIP ENTERS TURNING BASIN
LEGEND
LATERAL FORCE
LONGITUDINAL FORCE
MOMENT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FLOOD CONDITIONS
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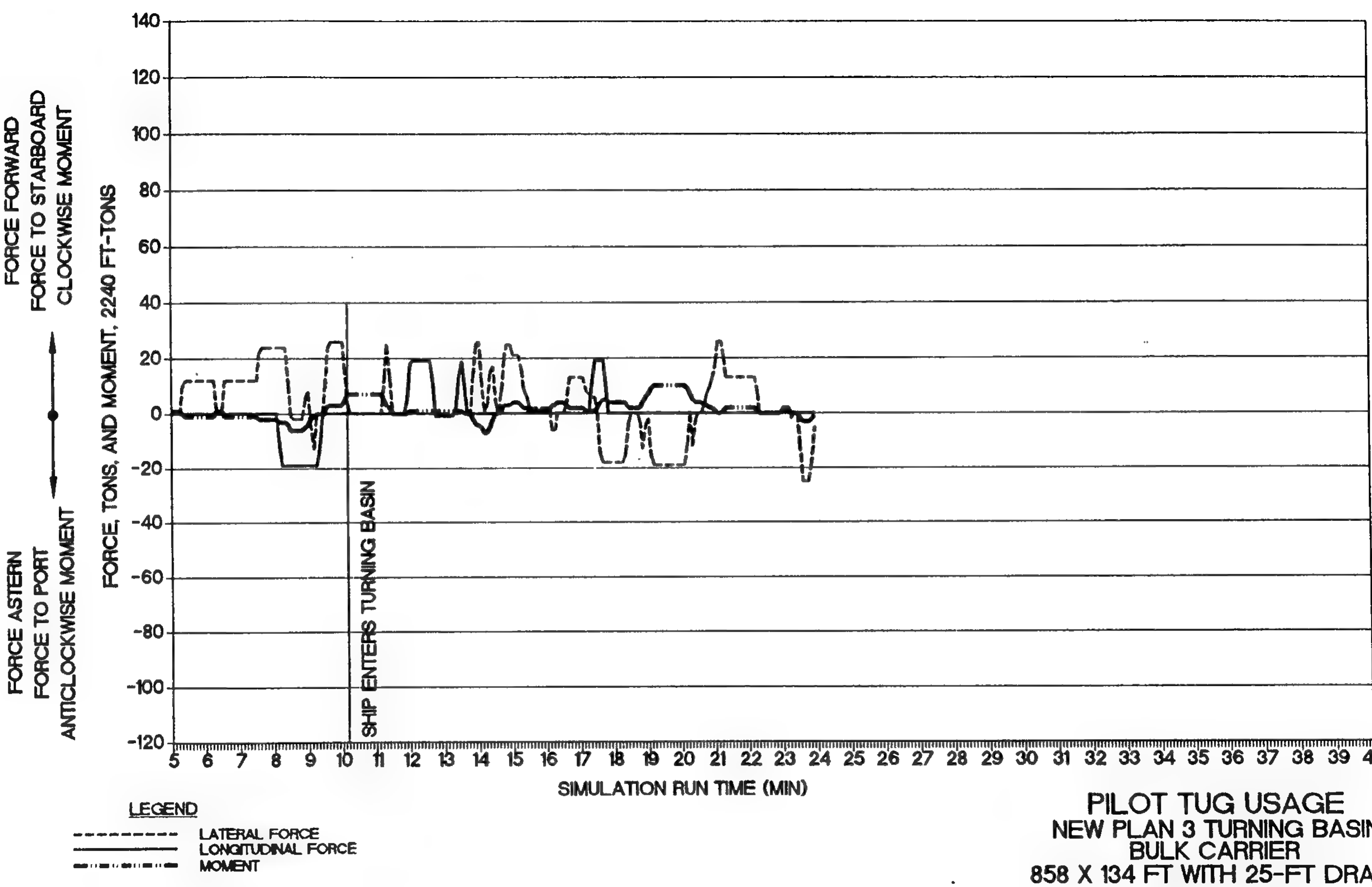

PILOT TUG USAGE
NEW PLAN 3 TURNING BASIN
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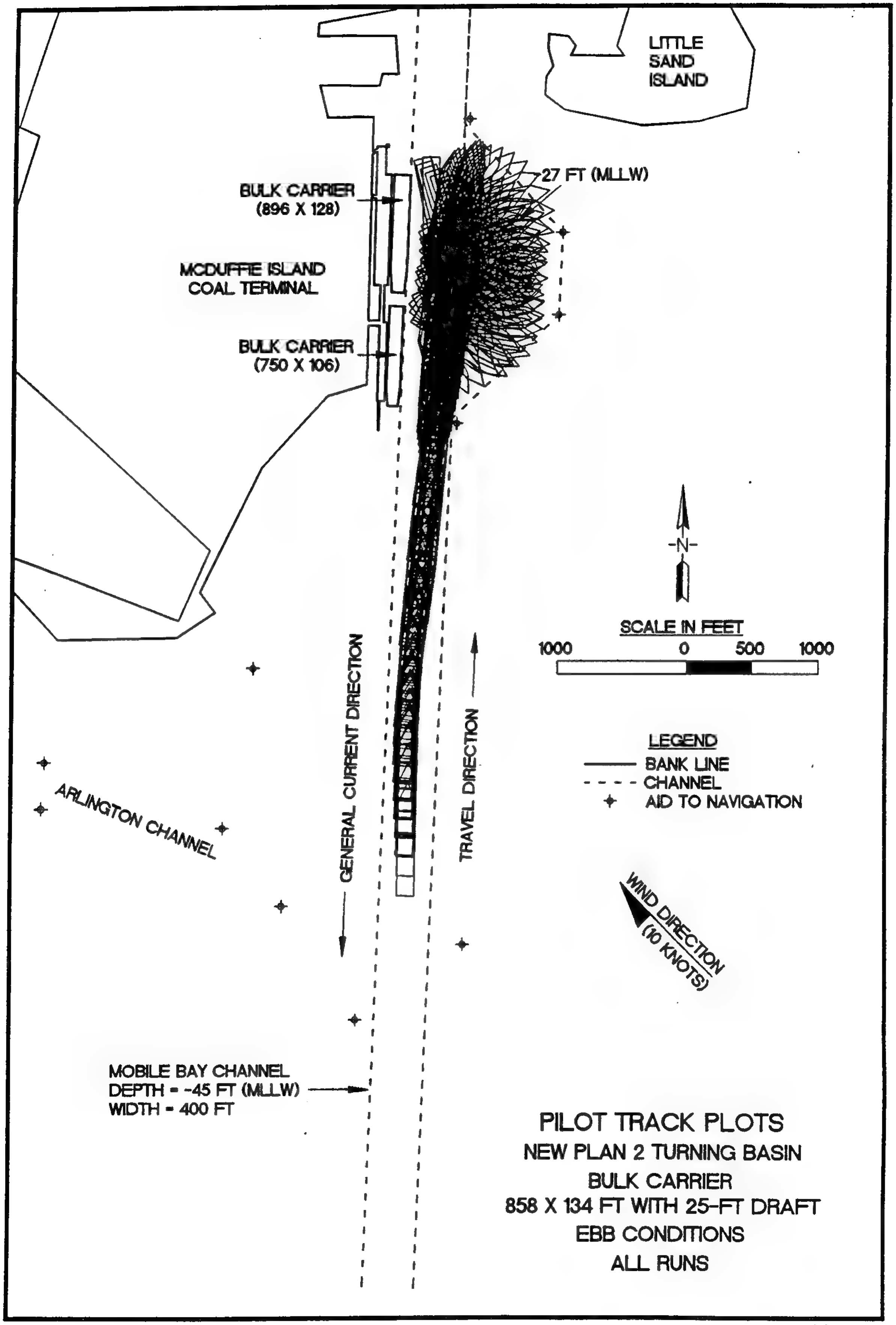
858 X 134 FT WITH 25-FT DRAFT
FLOOD CONDITIONS
PILOT J, RUN 2

Composite Trackplots
Additional Tests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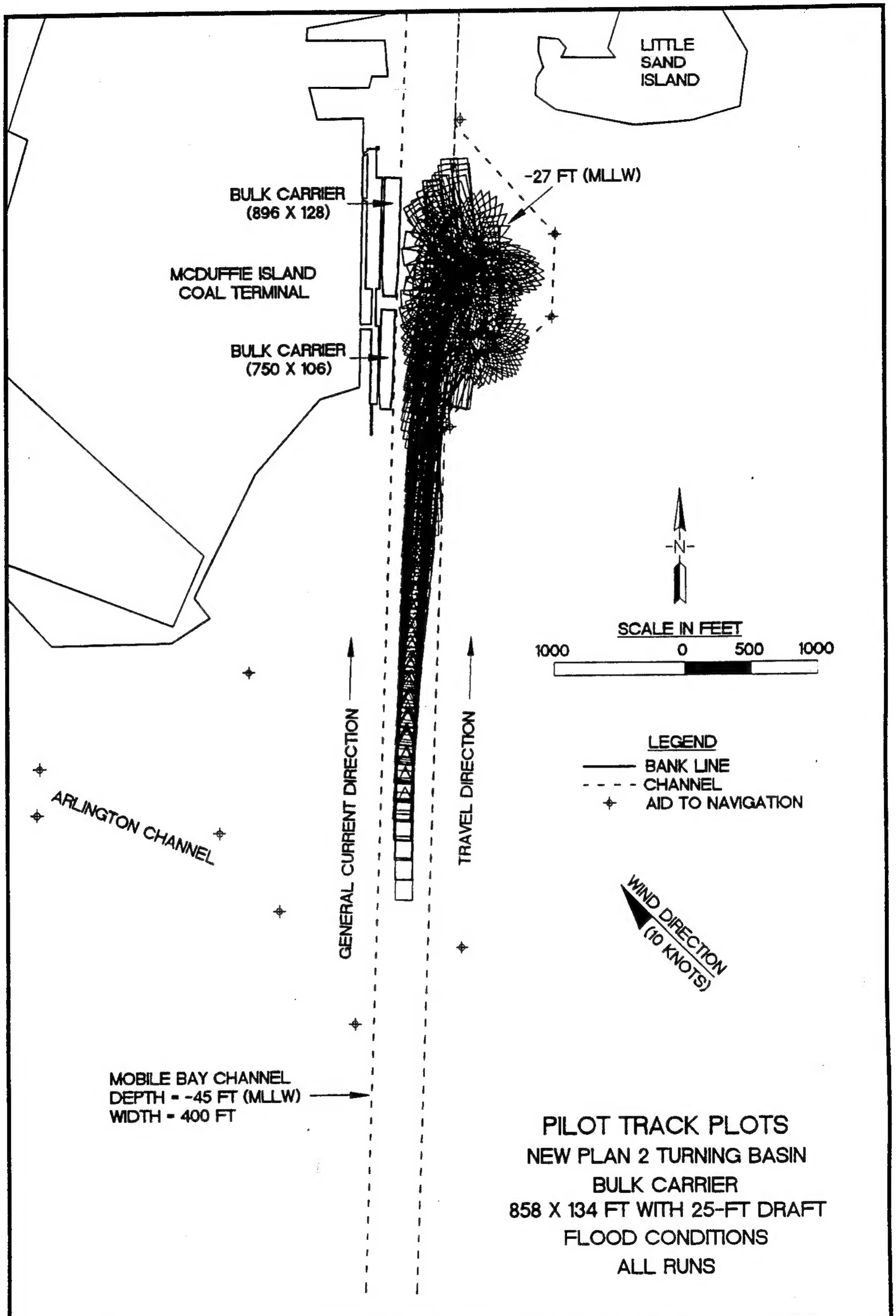
COAL TERMINAL
BULK CARRIER
(750 X 106)
-N-
SCALE IN FEET
1000 0 500 1000
LEGEND
BANK LINE
CHANNEL
AID TO NAVIGATION
GENERAL CURRENT DIRECTION
TRAVEL DIRECTION
ARLINGTON CHANNEL
WIND DIRECTION
(10 KNOTS)
MOBILE BAY CHANNEL
DEPTH = -45 FT (MLLW)
WIDTH = 400 FT
PILOT TRACK PLOTS
NEW PLAN 2 TURNING BASIN
BULK CARRIER
858 X 134 FT WITH 25-FT DRAFT
EBB CONDITIONS
ALL RUNS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COAL TERMINAL
BULK CARRIER
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-N-
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PILOT TRACK PLOTS
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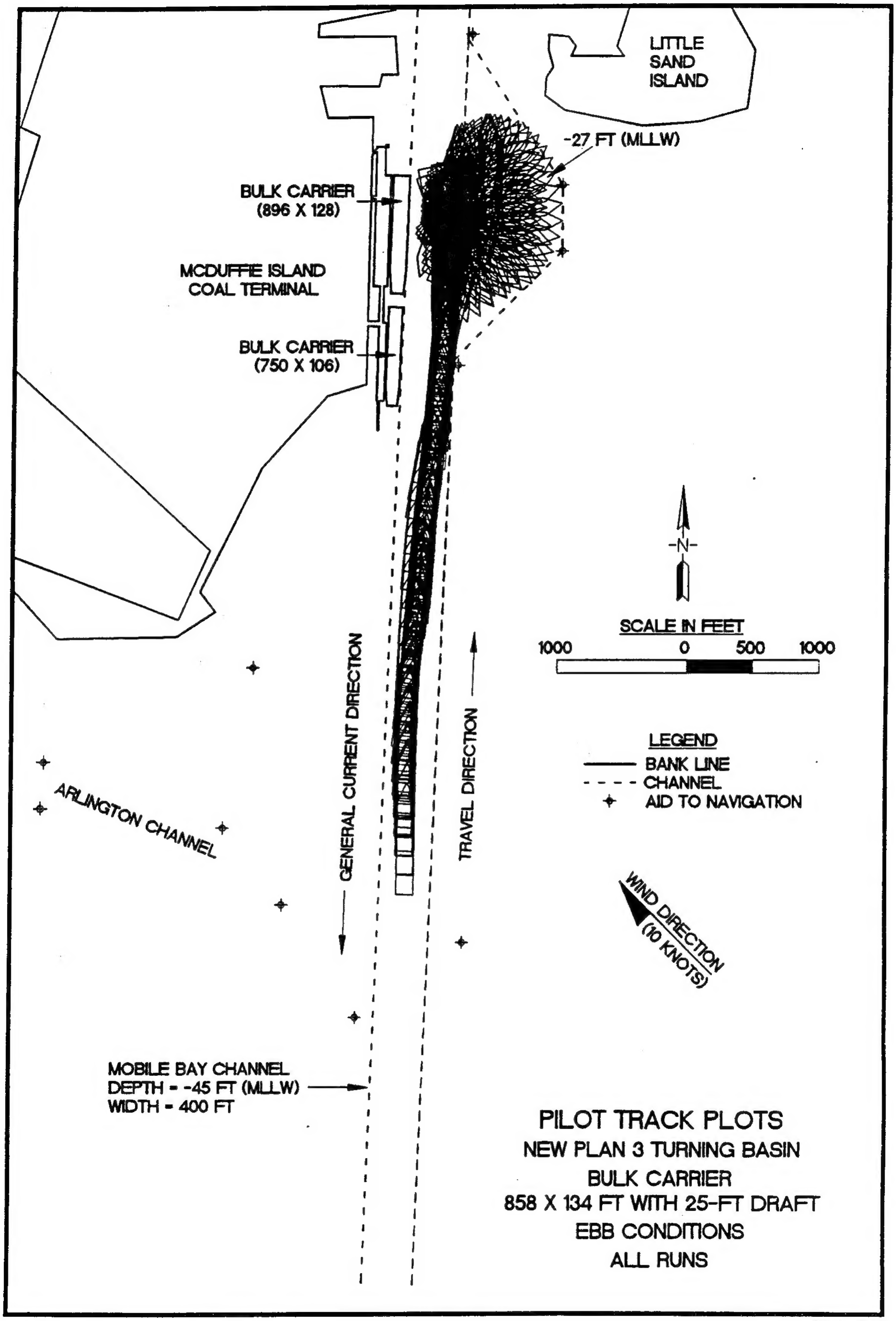
Plate 210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BULK CARRIER
(750 X 106)
SCALE IN FEET
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0
500
1000
LEGEND
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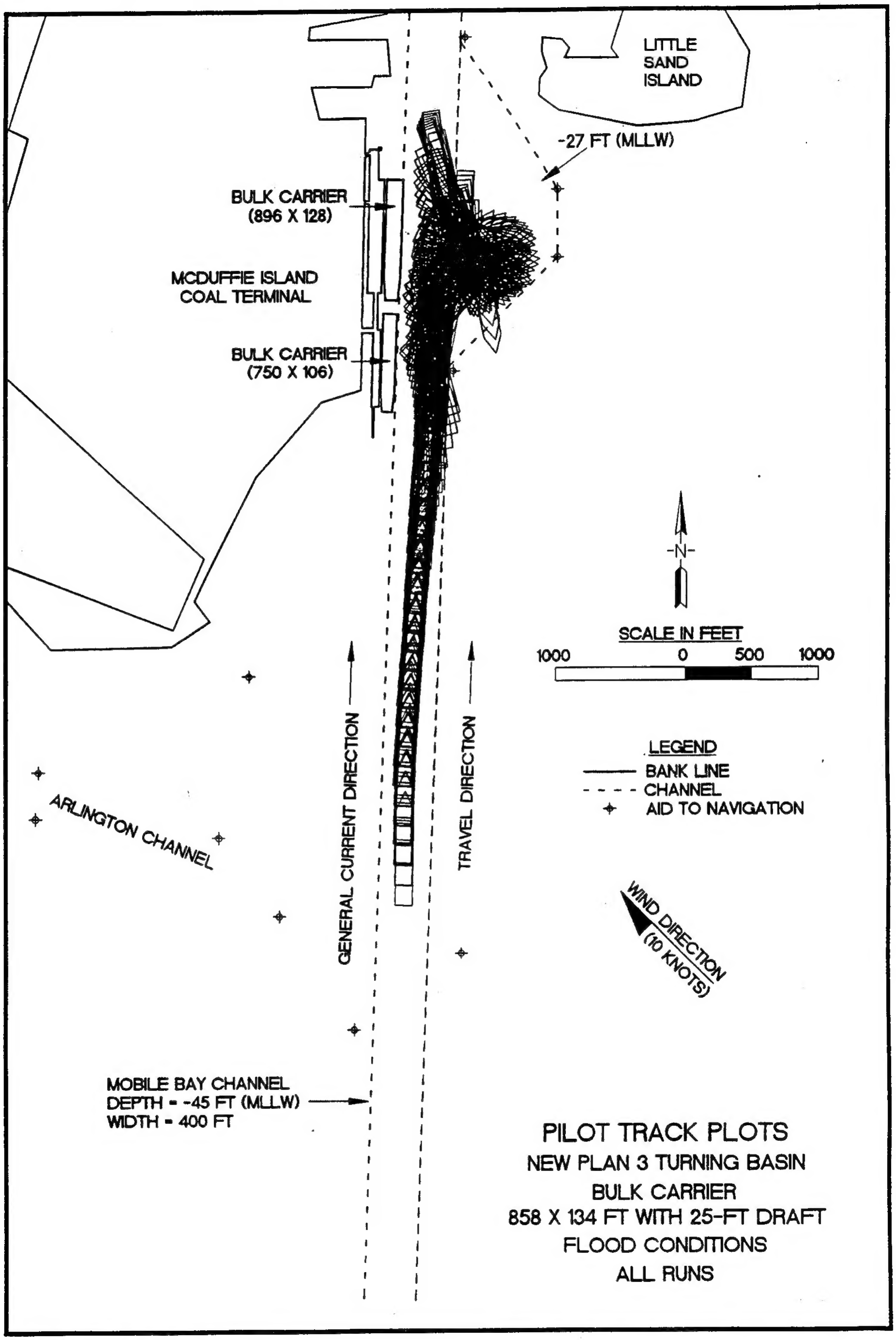
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0
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J. Christopher Hewlett

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13. ABSTRACT *(Maximum 200 words)*

A real-time ship simulation study of the proposed design for a turning basin in the navigation channel in Mobile, AL, was conducted. The basin is to be constructed opposite the State of Alabama coal dock at the northern edge of Mobile Bay. The purpose of the project is to provide adequate room for 950-ft-long bulk carriers to turn around safely and efficiently. Field data were used for channel currents in the simulation tests. Simulation validation and testing were conducted by professional pilots from the Mobile Bay Bar Pilots Association. Tests were conducted in Vicksburg, MS, on the U.S. Army Engineer Waterways Experiment Station ship simulator.

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